MODEL TTS 176
DIALED NUMBER RECORDER

15

NORTHEAST ELECTRONICS CORPORATION

P.O. BOX 649 – CONCORD, N.H. 03301

(603) 224-7466

MODEL TTS 176
DIALED NUMBER RECORDER

Issue #1

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NORTHEAST ELECTRONICS CORPORATION
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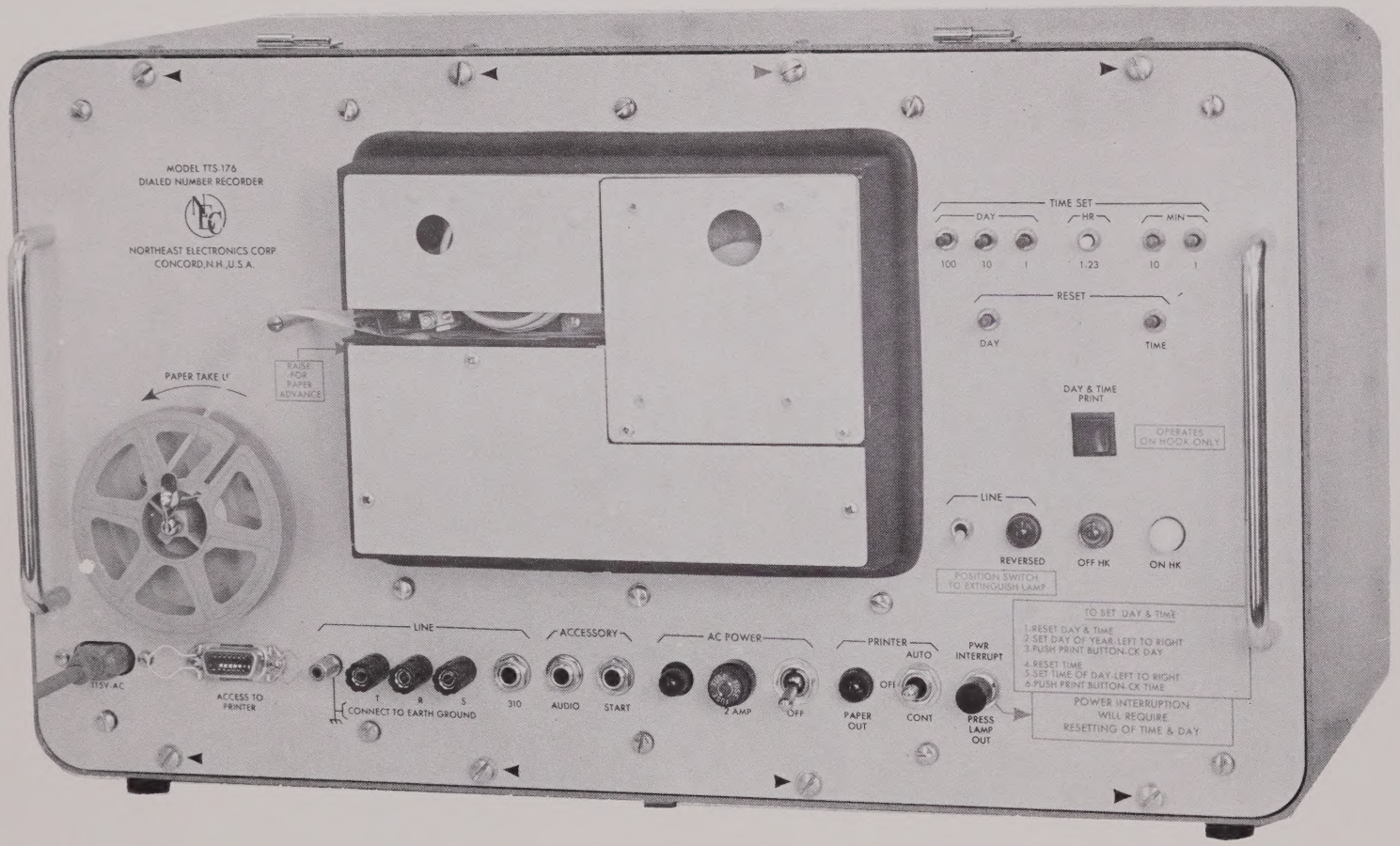

MODEL TTS-176
DIALED NUMBER RECORDER
NORTHEAST ELECTRONICS CORP.
CONCORD, N.H., U.S.A.
PAPER TAKE UP
RAISE FOR PAPER ADVANCE
TIME SET
DAY
HR
MIN
100
10
1
1.23
10
1
RESET
DAY
TIME
DAY & TIME PRINT
OPERATES ON HOOK ONLY
LINE
REVERSED
OFF HK
ON HK
POSITION SWITCH TO EXTINGUISH LAMP
TO SET DAY & TIME
1. RESET DAY & TIME
2. SET DAY OF YEAR-LEFT TO RIGHT
3. PUSH PRINT BUTTON-CK DAY
4. RESET TIME
5. SET TIME OF DAY-LEFT TO RIGHT
6. PUSH PRINT BUTTON-CK TIME
POWER INTERRUPTION WILL REQUIRE RESETTING OF TIME & DAY
115V AC
ACCESS TO PRINTER
LINE
T
R
S
CONNECT TO EARTH GROUND
310
ACCESSORY
AUDIO
START
AC POWER
2 AMP
OFF
PRINTER
AUTO
OFF
PAPER OUT
CONT
PWR INTERRUPT
PRESS LAMP OUT

SECTION 1

DESCRIPTION AND SPECIFICATIONS

1.1 GENERAL DESCRIPTION

1.2 The Model TTS 176 Dialed Number Recorder is a transistorized, portable unit designed to provide a permanent printed record of the number dialed or keyed by a telephone subscriber, along with the date (day of the year) and time at the beginning and end of the call. The unit records DC loop pulses as well as touch tone signals. It can be supplied with options to display MF and SF signaling if desired.

1.3 Line input terminals are provided to connect the subscriber line to the high impedance bridging circuit. The bridging circuit is of sufficient impedance so that the circuit characteristics of the line under surveillance are not changed.

1.4 The internal electronic calendar and clock provide the day of the year, hours, and minutes for printout. Switches located on the front panel allow the operator to set the calendar and clock to the correct date and time. The time base is 60 Hz.

1.5 The TTS 176 utilizes an internal high speed paper strip printer using self-inking impact paper. The printout data for an outgoing call consists of:

a. Date and time of the initial off-hook condition by the subscriber.

b. Digits dialed or keyed.

c. Date and time of the termination of the call.

The printout data for an incoming call consists of only the date and time of the answer and disconnect by the called subscriber.

1.6 The Model TTS 176 is designed to operate from 115V, 60 Hz and requires approximately 150 watts of power. The unit is housed in a portable carrying case measuring 12" x 21½" with a depth of 14½". The unit weighs 48 lb.

1.7 The Model TTS 176 consists of three basic groups of circuits located on a common mounting panel contained within an aluminum carrying case. The unit is intended for vertical operation and will give best service in this position. The functions of the three basic circuits are as follows:

a. Receive Circuits - The receive circuits distinguish on and off

hook from dial pulses and translate the touch tone signals appearing on a subscriber loop circuit. They also recognize the interdigital period and provide a print command during this period. The input impedance is in excess of 100KΩ. On-hook, off-hook and reversed line indicator lamps are controlled by the receive circuit. These circuits are solid state active components and are contained on plug-in cards for ease in maintenance.

b. Date and Time Circuits - These circuits supply the numerical day of the year, the hour of the day and minutes. The recognition of an off hook condition initiates the interrogation of the date and time, which is then printed prior to the dial pulse information.

The date and time circuits are of solid state design utilizing integrated circuits. These are contained on plug-in cards for ease of maintenance. Switches located on the front panel are provided to advance the clock circuits to the proper day of the year, hour, and minutes. Verification of the date and time setting is accomplished by depressing the PRINT pushbutton and observing the results on the paper tape. The accuracy of this date and time clock is determined by the frequency accuracy of the AC line. A sustained power failure may require the resetting of the clock circuits. An indication that power has failed is provided by the POWER INTERRUPTION lamp.

c. Printout Circuit - The printout device is a strip printer utilizing self-inking impact paper tape. The use of self-inking tape eliminates the necessity for the continuous surveillance of the inking action required with many printout devices.

The average printing rate is 20 characters per second, which is in excess of that required. The paper is advanced only when print commands are received.

1.8 MECHANICAL & ELECTRICAL INSPECTION

1.9 Upon receipt of the TTS 176 Dialed Number Recorder, a mechanical and electrical inspection should be performed.

1.10 The mechanical inspection will require the removal of the instrument from the case by loosening the eight attaching screws. Check for proper installation of all printed circuit cards and other components. Check to be certain there are no loose components or broken wires.

1.11 The electrical inspection will require connection to 115V ac, 60 Hz

for the internal power supply. The input circuits will require connection to a subscriber loop or equivalent circuit. Refer to Section 2.2 for proper installation.

1.12 With the AC POWER switch turned on (up position), the following should be noted:

a. AC POWER light on.

b. PWR INTERRUPT light on - press the reset circuits. Light should then go out.

c. With LINE connections removed, the ON HK lamp should be lit. The REVERSED lamp may or may not be lit.

d. With the LINE inputs connected to a subscriber loop. The OFF HK lamp should operate when the subscriber removes his handset.

e. With both T (tip) and R (ring) inputs connected to the subscriber loop, the REVERSED lamp should be lit in only one position of the REVERSED switch.

f. The S (sleeve) input is not used.

1.13 With AC POWER turned on, the printer and paper take-up motor should operate as follows from the PRINTER switch.

a. Center position (OFF) - motors off.

b. Down position - (CONT) - motors on continuously.

c. Up position (AUTO) - motors off (on hk)
- motors on (off hk)

1.14 To check the TIME & DAY circuits, the AC POWER must be on, the PRINTER power switch in the CONT position and the lamps must show ON HK.

a. The instructions for setting up the day and time are to be found on the front panel. Note that a day/time print cannot be obtained if the off hook lamp is lit.

b. An internal battery is used for preserving the day and time during momentary AC power interruptions. To check storage unplug the AC cord momentarily. With AC power again restored, check for an unchanged time and day print.

NOTE: Disconnecting the AC power cord with the AC POWER switch turned ON will cause the discharge of the internal storage battery.

1.15 To advance the paper through the printer, the printer motor must be operating. The location of the paper advance lever is noted on the front panel. Do not pull the paper through. Refer to the maintenance section for correct paper installation.

1.16 SPECIFICATIONS

SUPERVISION & LOOP PULSING

a. Low Pass Filter to reject 60 Hz.

b. Input Resistance of 100K minimum from Line to Ground.

c. Input Impedance in excess of 100KΩ to ground.

d. Dialing pulses less than 20ms are rejected (adjustable).

TONE DIALING - Touch Tone or MF

a. Dynamic range of 25-40 dB all tones. Set to accept -20 dBm signal minimum.

b. Bridged input impedance is greater than 100K.

c. Not sensitive to impulse noise.

POWER: 100-135V ac 60 Hz 150 watts

SIZE: 12" x 21½" x 14½" WEIGHT: 48 lb.

SECTION 2

OPERATING INSTRUCTIONS

2.1 FRONT PANEL CONTROLS

a. ACCESSORY jacks - The AUDIO jack (tip-ring) provides a low impedance output for the audio signal present on the subscribers line. The START jack provides for a relay contact closure on the tip-ring-sleeve. The relay is energized at the instant of OFF HK on the subscribers line and will remain energized until a few seconds after ON HK occurs. This jack is available for operating external equipment. All jacks accept 310 type plugs.

b. AC POWER - The power requirements for the TTS 176 are 115V ac, 60 Hz, single phase. All DC circuit power is controlled from the main power switch adjacent to the 2 amp fuse. The neon indicator lamp is connected across the power switch and should be lit at all times when AC power is on. The light is out if the 2 amp fuse is blown. Turn POWER switch OFF when AC power cord is disconnected.

c. PRINTER (AC power) - The printer and paper take-up AC motor power is derived from the PRINTER switch through a three-position toggle switch. The switch positions operate the printer as follows:

OFF - Printer power is off at all times.

AUTO - The printer motor will operate only when the subscribers telephone is off hook.

CONT - The printer motor will operate continuously. This position should be used for checking the day and time circuits.

d. PAPER OUT - The PAPER OUT lamp will operate when the printer has exhausted its paper supply. There is also provided in the printer a disable circuit to prevent damage to the printing mechanism.

e. PWR INTERRUPT - This is a lighted pushbutton switch that will indicate when DC power has been interrupted. This power interruption can be caused by AC power being interrupted momentarily. The lamp is operated through a relay that is reset when the lighted pushbutton is pushed in. The lamp should normally be off. If, at any time, the AC power is interrupted, the day and time circuits should be checked and reset as necessary. A battery circuit is installed to prevent loss of accumulated day and time during momentary AC power failures. The bat-

tery may become discharged through excessive use. DO NOT DISCONNECT POWER CORD AND LEAVE AC POWER SWITCH ON.

f. TIME SET/RESET - The DAY and TIME RESET switches are momentary toggle switches that will reset the day of the year and the time of the day, each independent of the other. The DAY, HR and MIN TIME SET switches are also momentary toggle switches that provide for the initial day and time setting.

g. DAY AND TIME PRINT - A pushbutton switch provides for a day and time print when the circuits indicate ON HK.

h. LINE Connections - A jack in parallel with binding posts is provided for connecting the TTS 176 to a subscribers line. Connect the T and R to a subscribers line using a cord equipped with 310 type plug if the jack is used. The GROUND connection should be made to the central office or earth ground. AC signal rejection is provided for longitudinal noise to ground.

i. LINE Switch and REVERSED Lamp - This switch allows the operator to reverse the T and R inputs in order to provide the proper polarity for DC supervision. The REVERSED lamp lights when the subscriber line polarity has been reversed.

j. OFF HK and ON HK Lamps - These lamps provide for a visual indication of on-hook and off-hook conditions on the subscribers line. A visual indication of proper dial pulsing can also be observed by the two lights flashing back and forth.

k. RAISE FOR PAPER ADVANCE LEVER - This lever, when lifted, causes the paper to run out continuously from the printer. Use for advancing the paper to read printed information.

l. ACCESS TO PRINTER (OPTION) - This plug provides for access to the printer input/output and data lines for a more general systems use. The following are available functions:

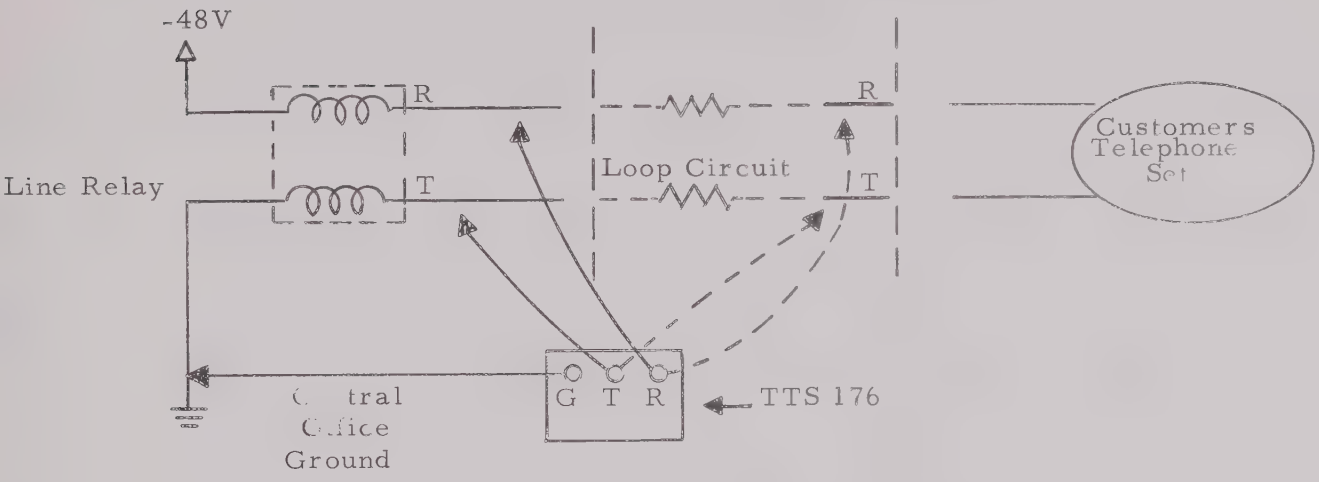
1. Spacing control
2. Print Command input
3. Print Command output (pos or neg)
4. 6 Binary lines for data input

2.2 INSTALLATION PROCEDURE

2.3 CONNECTION TO "LINE" TERMINALS OF TTS 176.

a. Ground the instrument to the central office ground. (Earth ground should be satisfactory when away from central office.

b. Connect the T and R inputs to the approximate diagram below.



c. Where tone signaling is not used, the T connection need only be made. Note that the T (tip) connection is on the grounded side of the line.

d. The unit should work equally well at either end of the subscriber loop.

2.4 OPERATING PROCEDURES

a. Turn the AC POWER switch on. The red indicator lamp will not light if fuse is blown.

b. Push PWR INTERRUPT button to extinguish the lamp.

c. Move the PRINTER power switch to the CONT position. The motor should operate continuously and any slack paper taken up.

d. Advance the paper manually by raising the lever noted on the front panel. The paper should move freely through the printer. Ensure that the paper has not unravelled from the storage reel or the take-up reel and has not slipped from its track through the printer. DO NOT PULL PAPER THROUGH.

e. If the indicator lamps show OFF HK and REVERSED, the REVERSED switch should be moved to the other position. If the OFF HK lamp is lit in either position of the LINE REVERSED switch,

then the subscriber is off-hook. To position the LINE REVERSED switch see notes 1 and 2 below.

NOTE 1: Where reversed battery answer supervision does not occur, the line reversal switch should be positioned so that the REVERSED lamp is OFF.

NOTE 2: Where reversed battery answer supervision did occur, the operator should position the reversal switch so that the REVERSED lamp is on.

NOTE: When the REVERSED lamp is on, the tone receiver (touch tone or MF) is disabled.

f. The operator will be able to obtain a day and time print only when the lamps indicate an ON HK condition. If a day and time print is required during a call it will be necessary for the operator to remove the LINE connections.

g. Procedure for setting the time and day:

1. Operate RESET DAY and RESET TIME toggle switches momentarily.

2. Set the day of the year beginning with the highest digit first (left to right): using TIME SET DAY, HR and MIN switches.

e.g. February 8 = 039th day of the year

Operate 100 column - no times
Operate 10 column - 3 times
Operate 1 column - 9 times

3. Push DAY & TIME PRINT button and check for correct day of year. Add additional counts if necessary or repeat step 1 and step 2.

4. Operate RESET TIME toggle switch momentarily.

NOTE: Time of day is reset to zero minutes.

5. Set time of day beginning with highest digit first (left to right).

6. Push DAY & TIME PRINT button and check for correct day and time print. Add additional counts if necessary or repeat

steps 4 and 5. It may also be necessary to repeat steps 1 and 2.

NOTE: Reversing the above procedure may cause the operator to be unable to set the required count in any one of the digits.

h. The TTS 176 should now be capable of recording all dialing whether Dial Pulse or Touch Tone.

i. Position the PRINTER power switch in the AUTO position. The printer and paper take-up motor will be inoperative until an off hook occurs.

2.5 PRINTOUT INTERPRETATION

The following example is given as a typical example of an outgoing call when the TTS 176 is connected to a subscriber line.

D057H1615 16032247466 D057H1630

The subscriber removed his handset on February 26th at 4:15 p.m. and dialed or keyed telephone number 1-603-224-7466. He hung up his telephone at 4:30 p.m.

Incoming calls are not usually indicated unless the subscriber answers his telephone. If he answers there would be a day and time print when the handset is picked up and again when it is hung up.

The following example is given for a call answered on January 24th at 10:05 a.m. and terminated at 10:35 a.m.

D024H1005 D024H1035

The touch tone receivers are designed to print characters for all eight frequencies available, many of which are not in use at this time. The characters printed for all possible two-tone combinations are as follows:

Hz	1209	1336	1477	1633
697	1	2	3	P
770	4	5	6	I
852	7	8	9	T
941	*	0	#	F

Although there is a great deal of protection against voice, music, etc., from causing talk-up it is difficult to eliminate entirely; however, the probability of an occurrence is small.

NOTE: When the REVERSED lamp is ON, the Touch Tone receiver is disabled. It is intended that the light operate when battery reversal answer supervision occurs to give positive protection against talk-up.

Some things to keep in mind when interpretating the printed tape are as follows:

1. The printing of a 1 during a call can be the result of a momentary ON HK or a switching transient. (Consult the maintenance section for an adjustment to control switching noise.)

2. Characters occurring in the last column of the above chart are not usually keyed and would likely be the result of digit simulation by audio signals on the line.

3. Digits could be keyed during an otherwise normal call when positive answer supervision is not available.

4. Grounded ringing on incoming call may cause a day and time print with each cycle whether party answers or not.

5. Bridging ringing on incoming calls will not cause a day and time print unless party answers.

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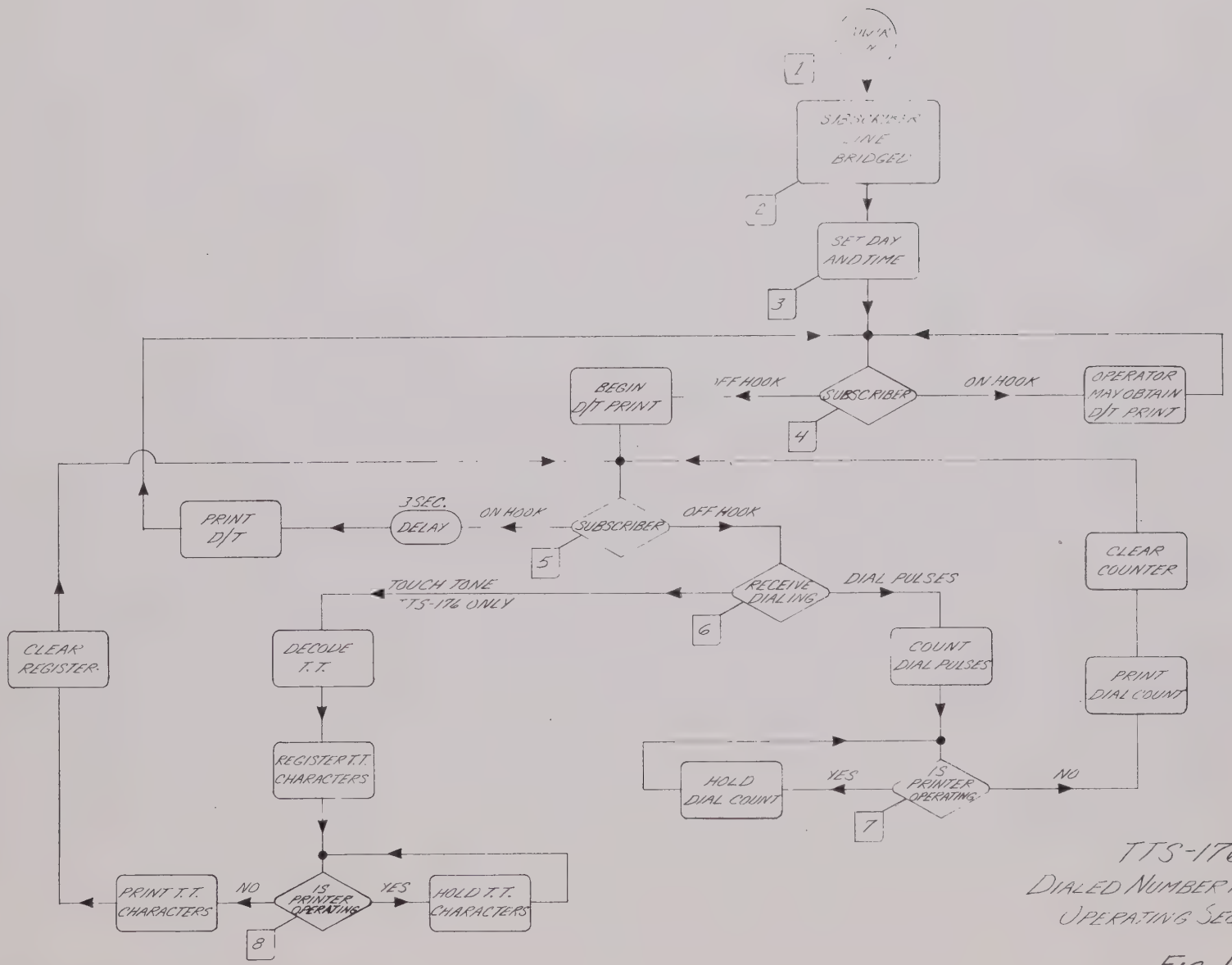


TTS-176
DIALED NUMBER RECORDER
OPERATING SEQUENCE

FIG. 1

SECTION 3

CIRCUIT DESCRIPTION

3.1 With reference to the attached Operating Sequence Drawing, Figure 1, the operation is as follows: (the step numbers coincide with the steps on the drawing):

(1) Connect to 115V ac and turn power on. An interlock circuit is provided to indicate any interruption of power necessitating resetting of the clock and calendar.

(2) The tip and ring of the subscriber line is connected to the input jack or terminals of the TTS 176. This is a bridge connection of high impedance and will not impair transmission or signaling on the line and cannot be detected without special apparatus. A ground connection is also required.

(3) Set the clock and calendar to the proper hour, minute and day of the year. The operator may call for a printout of the day and time by depressing a pushbutton.

(4) When an off hook is detected from the subscriber, a printout of the day and time occurs.

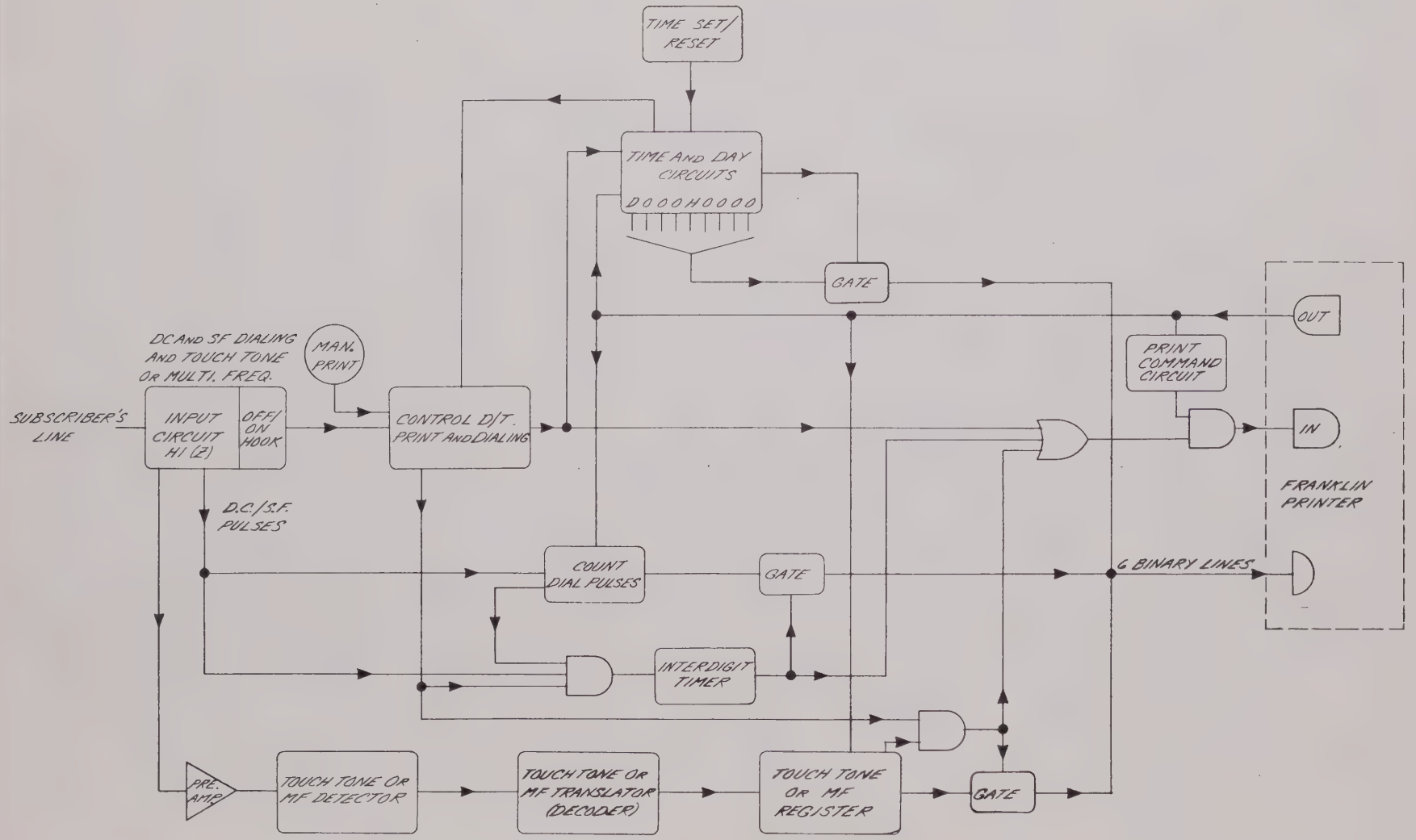
(5) The off hook from the subscriber prepares the detector circuits to count the digits dialed or keyed. When the subscriber returns to on hook, a day and time printout will again occur after a delay of 3 seconds.

(6) Either loop pulsing or touch tone signaling may be detected and decoded for printout. This is a parallel operation and requires no selection by the operator.

(7) LOOP PULSING: The unit will count the pulses received and print each digit during the interdigital period. In the event the first digit occurs before the initial day and time printout is complete, it is stored until the printer is free.

(8) TOUCH TONE SIGNALING. The unit receives the tones and translates into the proper character for printout. Up to two digits can be stored, should the printer be occupied with a day and time or a previous digit printout.

The subscriber may return to on hook at any time and the flow chart will immediately branch from any point to step 5.



TTS-176
DIALED NUMBER RECORDER
FIG 2

3.2 Refer to block diagram, fig. 2, for circuit functions.

3.3 The Printed Circuit Cards are described by function in the following paragraphs. The circuit drawings follow in the same order for each board. NEC board numbers are prefixed by an E with a 5-digit number following.

3.4 SELECTIVE DETECTOR E95236 (4 cards used). These cards accept the dual tone signals from the input circuit card (E95304) to detect the individual tones for the touch tone decoder card, E95289. Each card consists of two stagger-tuned filter detectors which operate a relay output. These cards are used for touch tone, MF and SF tones by appropriate tuning.

3.5 TOUCH TONE DECODER E95289. This card consists of the necessary integrated logic circuits to decode the two tones at a time into the equivalent BCD on the six lines into the touch tone register.(E95290). There is available from the card a clocking output to drive the touch tone register. The clocking pulse will not occur if more than one low tone or one high tone occurs simultaneously.

3.6 TOUCH TONE REGISTER (E95290). The 6-line (bit) code from the decoder card (E95289) is accepted by the register card as a parallel entry in two stages and the output is directly available to the printer for a character printout. This card will store two characters if the printer should be occupied with a day and time printout or a previous character printout.

3.7 PRINT COMMAND AND SHIFT REGISTER (E95291). The Print Command circuitry is designed to operate with the printer in a closed loop. The circuit receives a clock pulse from the printer electronics and after a 5-10 ms delay, is available again for driving the printer. The gating to start the cycle can come from either the T/D control and dial pulsing (E95292) or the touch tone register. The shift register provides for a one through ten propagation to read parallel information in serial form from the time base card (E95292) and the calendar card (E95295). The necessary clock pulses are provided from the printer electronics cards (E95306 and E95307).

3.8 T/D CONTROL AND DIAL PULSING (E95292). This card performs the control function associated with sensing the off-hook condition, providing for the time and day printout and recording dial pulses for the equivalent six line code to the printer. The print command to card E95291 is provided by an interdigital timer.

3.9 POWER SUPPLY E95293. This card provides for the following regulated voltages used in the TTS 176: -26V, +15V, +5Vdc. The transformer rectifiers and filter circuits are located on the back of the support panel for the printer. The 60 Hz time base for the clock circuits are located on this card and the 60 Hz pulses. An adjustment for each voltage is available if needed. All 3 fuses for DC power are located on this board.

3.10 TIME BASE E95294. The 60 Hz pulses from the power supply card are converted into a 24-hour clock on this card. The readout is done in serial order and provides for the 24 hours and minutes of the hour. To provide the serial output, the shift register lines from card E95291 are used.

3.11 CALENDAR E95295. This card is a continuation of the Time Base card and will provide for the day of the year as 365 or 366 days. There is a switch provided on the board for selecting 365 or 366 days. The output is read in serial order with the output lines from the shift register card.

3.12 TIME & DAY SWITCHBOARD E95305. This board mounts behind the front panel day and time set and reset switches. The card provides the necessary clock pulses to reset and set up the correct time of day and day of the year in cards E95294 and E95295.

3.13 F.P. INPUT COMPARATOR & BINARY COUNTER E95306. This is the first of two cards used with the printer. The card accepts the 6-line binary input from the TTS 176 electronics and compares the 6 lines to the 6-bit counter driven by the printer. When the comparison is made, and a print command signal from card E95291 is given, then an output pulse is passed to the driver card E95307. The comparator card also contains a disable circuit when the paper supply is exhausted.

3.14 F.P. PRINT/SPACE DRIVER E95307. The comparator pulse from card E95306 is used on the Print/Space Driver card to drive the timed sequence of a print driver pulse and a space driver pulse in that order to the printer solenoid circuits. Card E95307 also provides the circuits to furnish the clocking pulses from the printer to the binary counter of card E95306.

3.15 DC INPUT CIRCUIT E95457. This card provides for all DC supervision and loop pulsing. The circuit consists of a limiter, a low pass filter with a comparator and a pulse rejection circuit. This card also contains the AC input transformer, monitor amplifier and a line battery reversal detector. A cut-off circuit disables the AC output to the AC INPUT circuit (E95458) when battery reversal occurs on a loop. The OFF and ON HK lamps and LINE REVERSED lamps are operated from this card.

3.16 AC INPUT CIRCUIT E95458. This card provides for receiving the audio signals present on a subscriber loop, filtering out the power line noise, and then separating the signals by two band rejection filters. The signals are then passed through limiters and on to the low and high group detectors. The only adjustments available on this card are those of the limiter outputs to the detectors.

3.17 RELAY BOARD E95407. This card provides for control of the following functions:

a. Relay switching for the automatic mode of the printer. Provides 115V ac to the Printer only during the off-hook interval.

b. Dry contact relay closure for the accessory start jack.

c. Relay operation of the power interrupt circuit.

d. The step down of 115V ac 60 Hz to provide a 60 Hz time base in the clock circuits. The 60 Hz from the relay board is first passed to the power supply board for logic level adjustment.

3.18 INTERCONNECTION BOARD #1 E95308. This card is located on the right-hand card cage and does the necessary interwiring of the following pc cards:

E95236 - Detectors (4 cards)
E95289 - Decoder
E95290 - Register
E95291 - Print & Shift
E95292 - T/D Control
E95294 - Time Base
E95295 - Calendar

3.19 INTERCONNECTION BOARD #2 E95410. This card is located on the left-hand card cage and does the necessary interwiring of the following 7 pc cards:

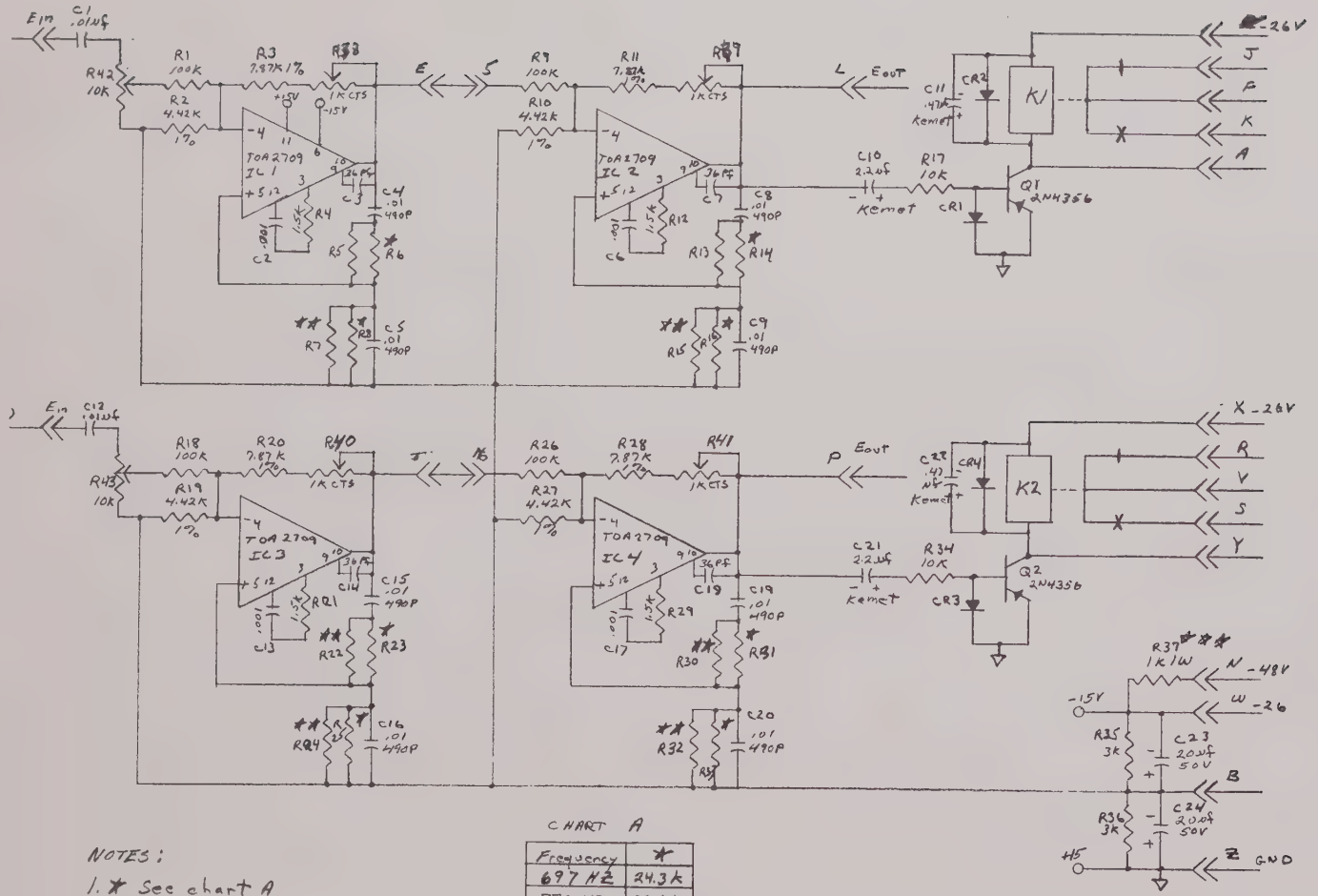
E95293 - Power Supply
E95306 - F.P. Comparator
E95307 - F.P. Driver
E95407 - Relay Board
E95457 - DC Input
E95458 - AC Input
E95236 - S.F. Detector (Optional)

There are provisions for options on this interwiring board.

SECTION 4, MAINTENANCE AND CALIBRATION INSTRUCTIONS, will be issued at a later date.

SECTION 5

DIAGRAMS & DRAWINGS FOR THE MODEL TTS 176



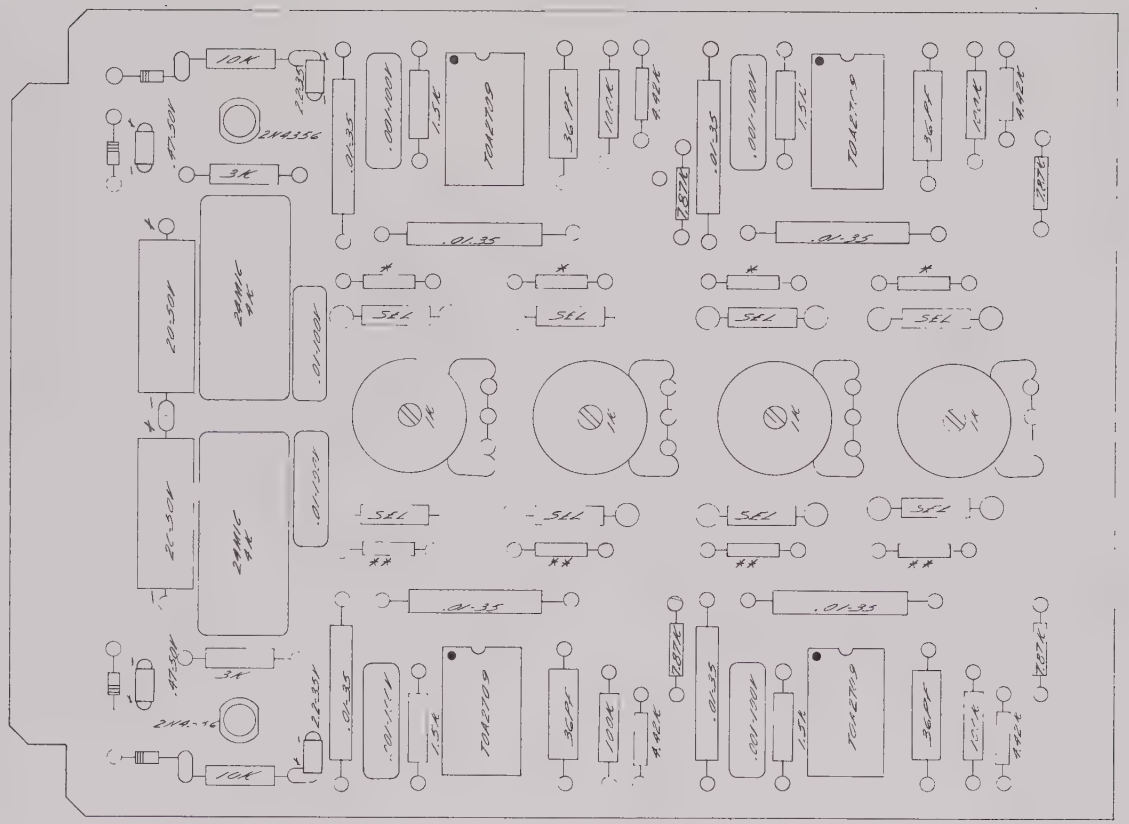
NOTES:

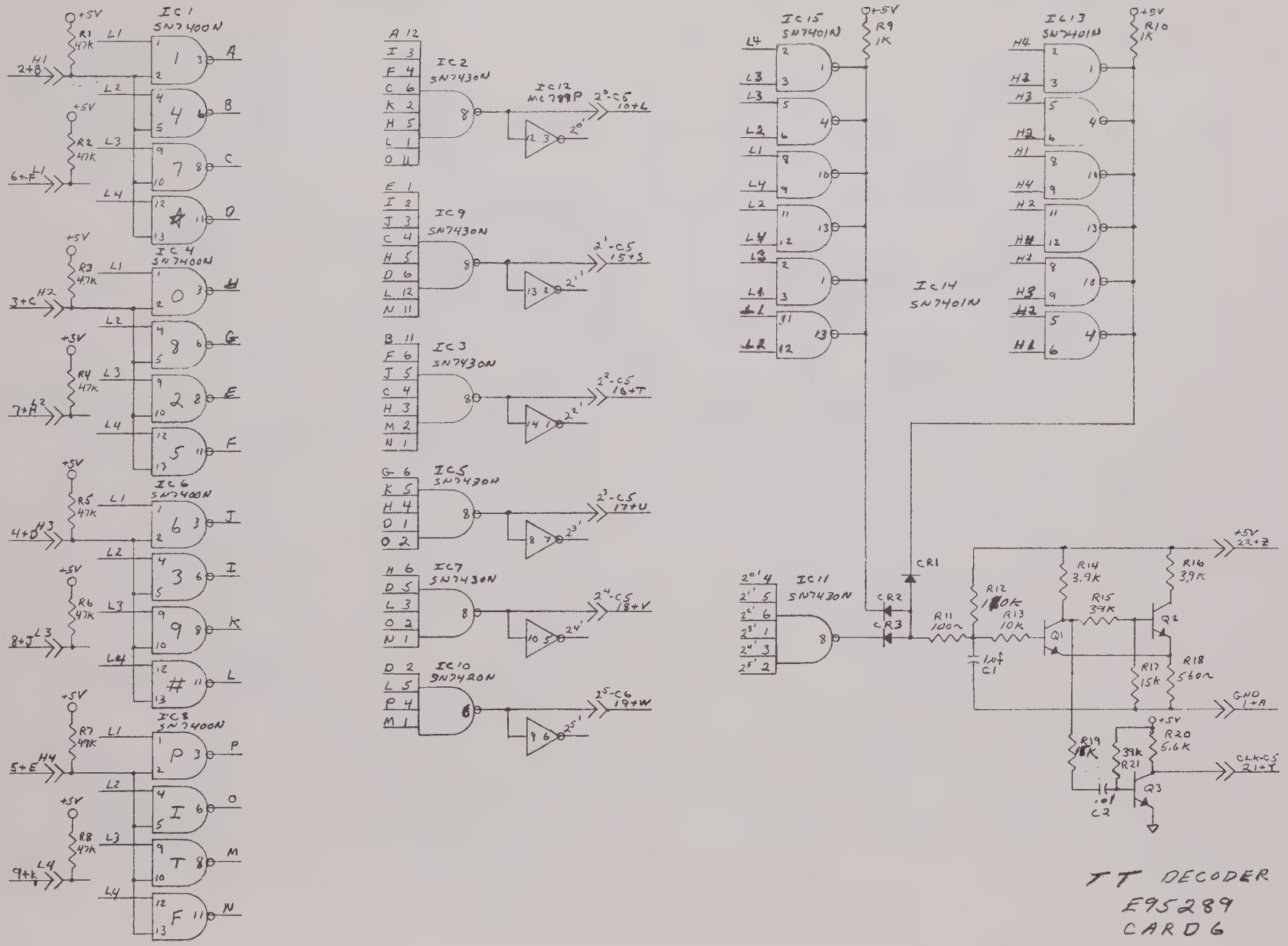
1. ★ See chart A
2. ★★ Padding resistors
3. All diodes IN4148
4. ★★★ -48V not to be used if -26V is used.

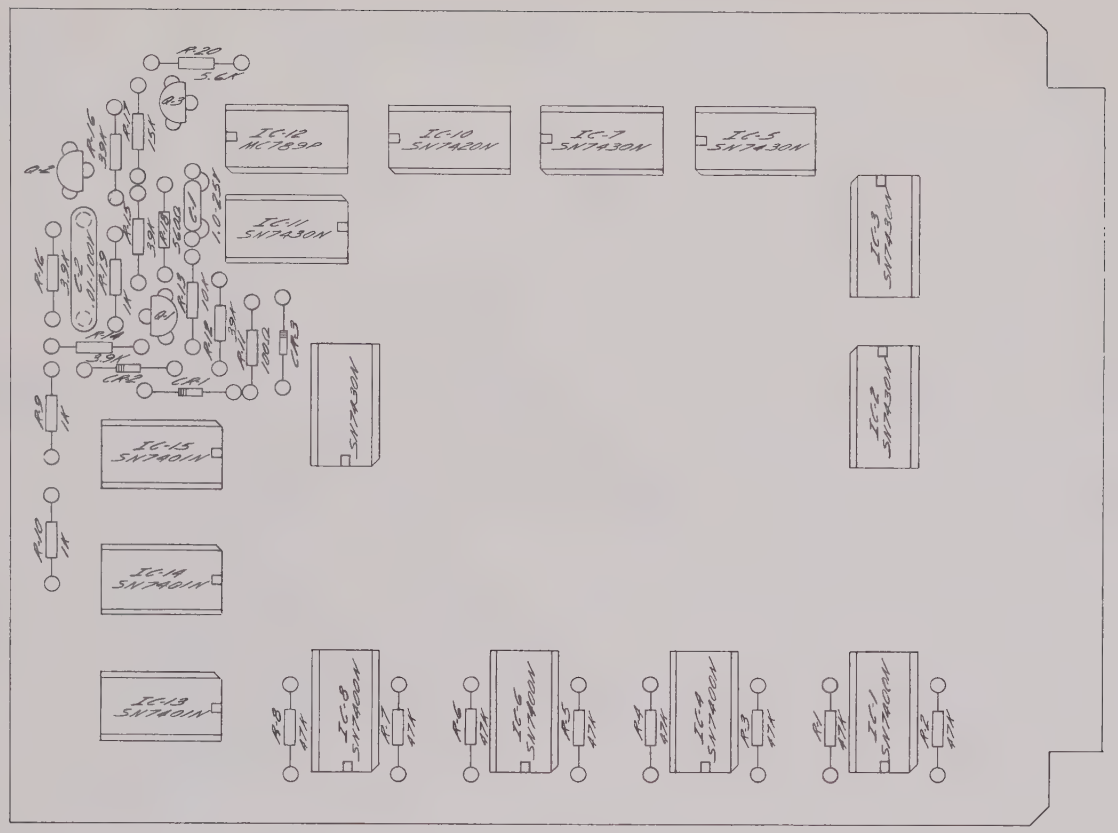
CHART A

Frequency	★
697 HZ	24.3K
770 HZ	22.6K
852 HZ	20.5K
941 HZ	17.8K
1209 HZ	14.3K
1336 HZ	13K
1477 HZ	11.8K
1633 HZ	10.5K

SELECTIVE DETECTOR
E95236
CARD 7-10


10K
2N4356
3K
.01-35
TONEPOD
2N4402
2N4403
.001-100
1.5K
.01-35
TONEPOD
2N4402
2N4403
.001-100
1.5K
.01-35
2N4402
2N4403
.001-100
1.5K
.01-35
TONEPOD

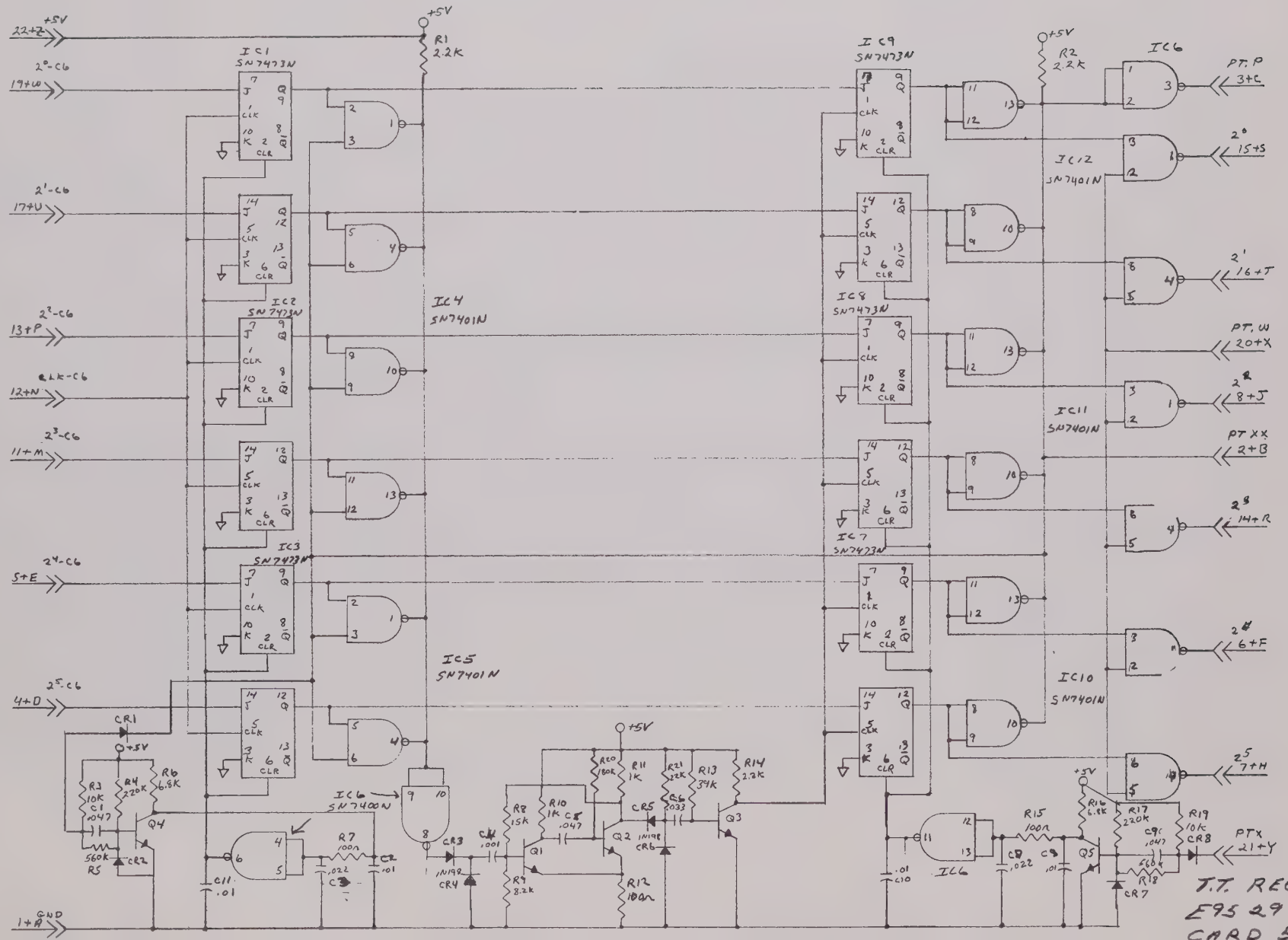

IC1 SN7400N
IC4 SN7400N
IC6 SN7400N
IC8 SN7400N
IC2 SN7430N
IC9 SN7430N
IC3 SN7430N
IC5 SN7430N
IC7 SN7430N
IC10 SN7420N
IC12 MC7899P
IC15 SN7401N
IC13 SN7401N
IC14 SN7401N
IC11 SN7430N
R1 47K
R2 47K
R3 47K
R4 47K
R5 47K
R6 47K
R7 47K
R8 47K
R9 1K
R10 1K
R11 100Ω
R12 180K
R13 10K
R14 3.9K
R15 39K
R16 3.9K
R17 15K
R18 560Ω
R19 18K
R20 5.6K
R21 39K
CR1
CR2
CR3
C1 1uf
C2 .01
Q1
Q2
Q3
+5V
GND
TT DECODER
E95289
CARD 6



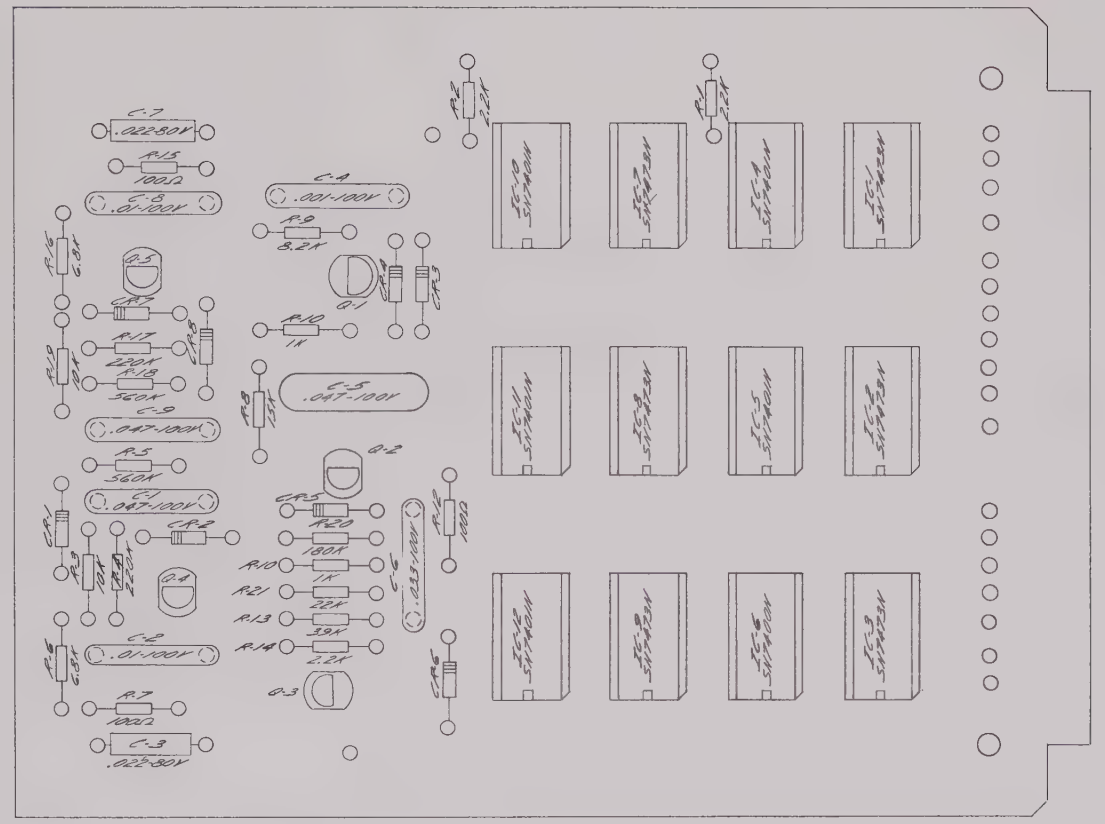
NOTES:
ALL TRANSISTORS = MPS-6515
ALL DIODES = IN4148

P.C. Bd Assy
E-95289

TTS-176



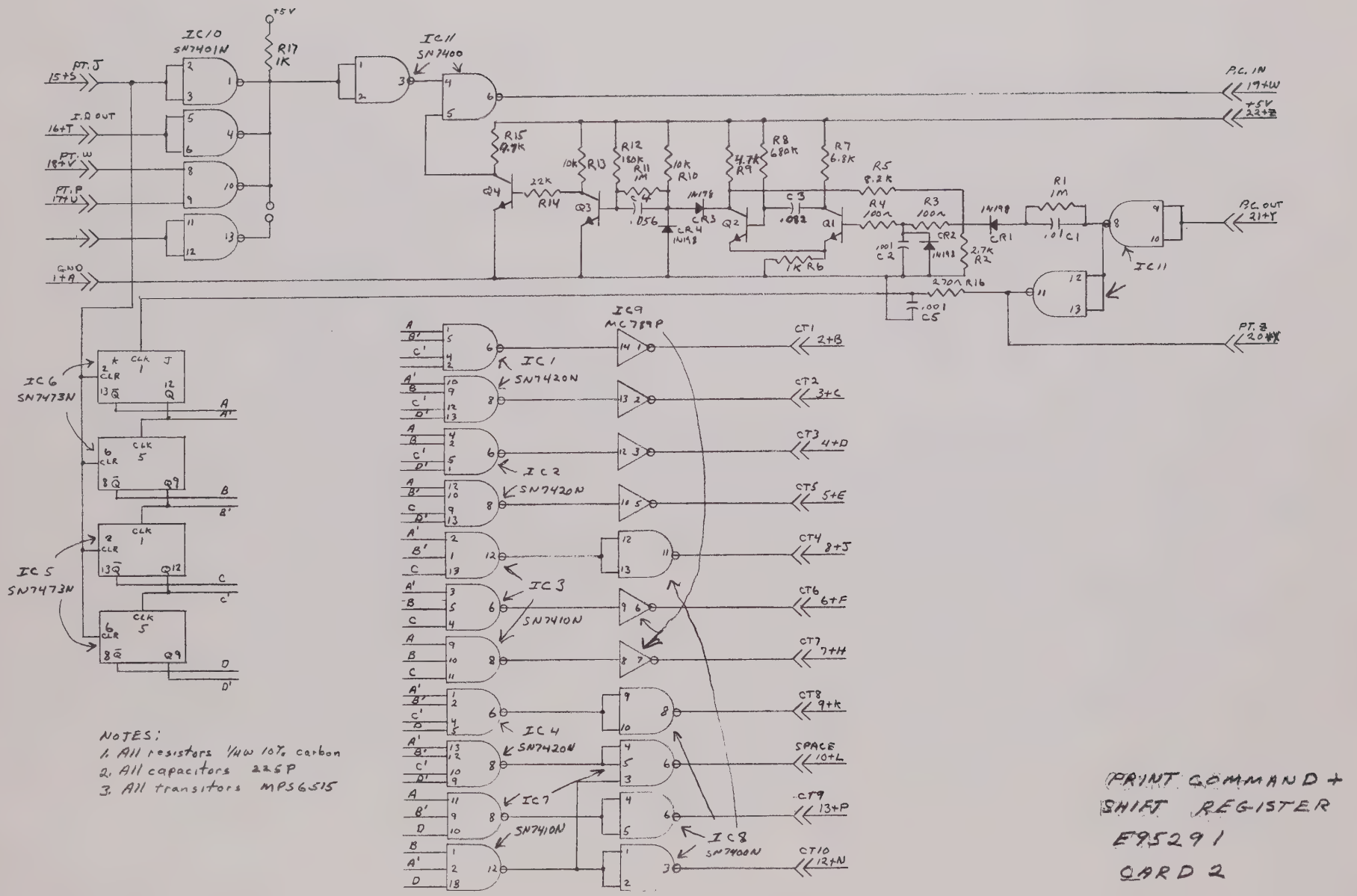
T.T. REGIST
E95290
CARD 5



NOTES:
ALL TRANSISTES MPS-6515
ALL DIODES 1N1198

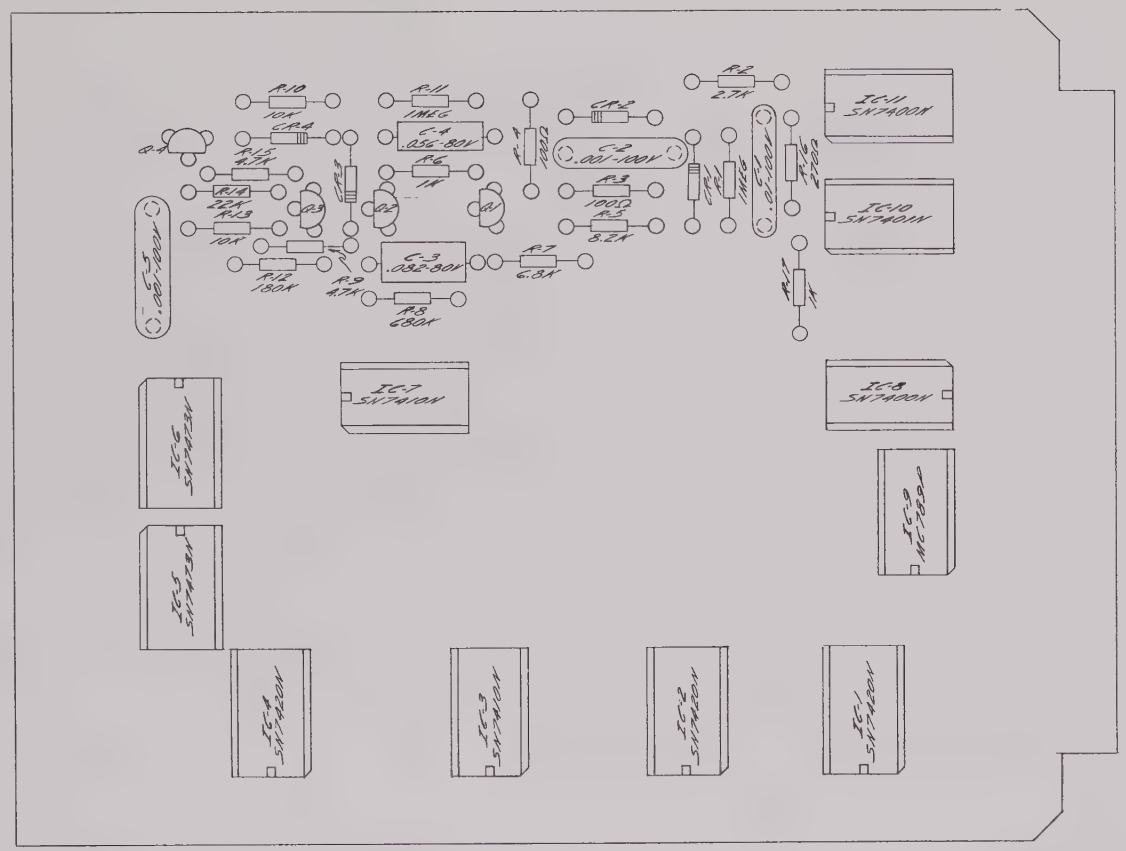
P.C.Bd. Ass'y
E-95290

TTS-176



NOTES:
1. All resistors 1/4W 10% carbon
2. All capacitors 225P
3. All transitors MPS6515

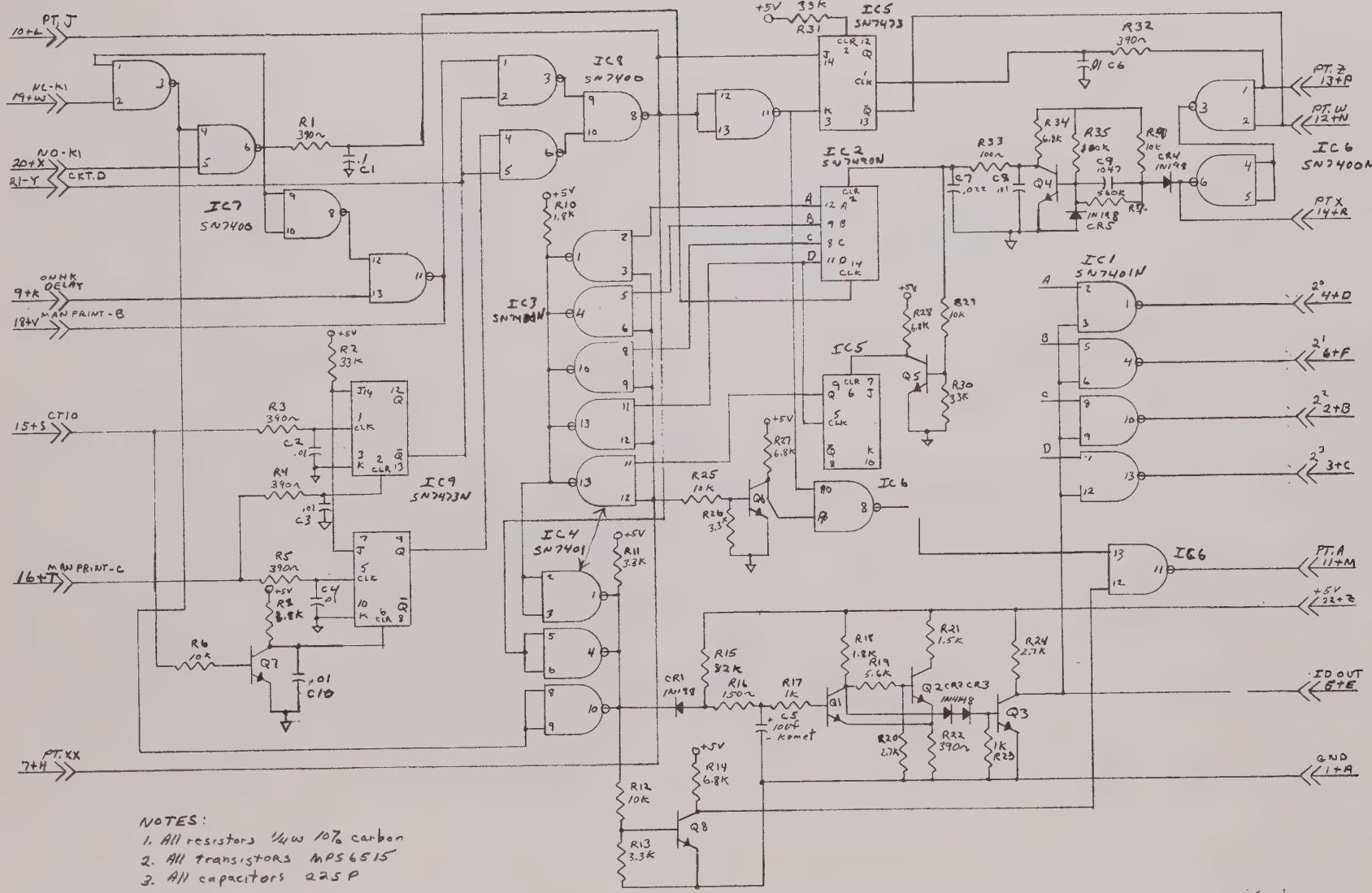
PRINT COMMAND + SHIFT REGISTER
E95291
CARD 2



NOTES:
ALL TRANSISTERS = MPS-6518
ALL DIODES = 1N198

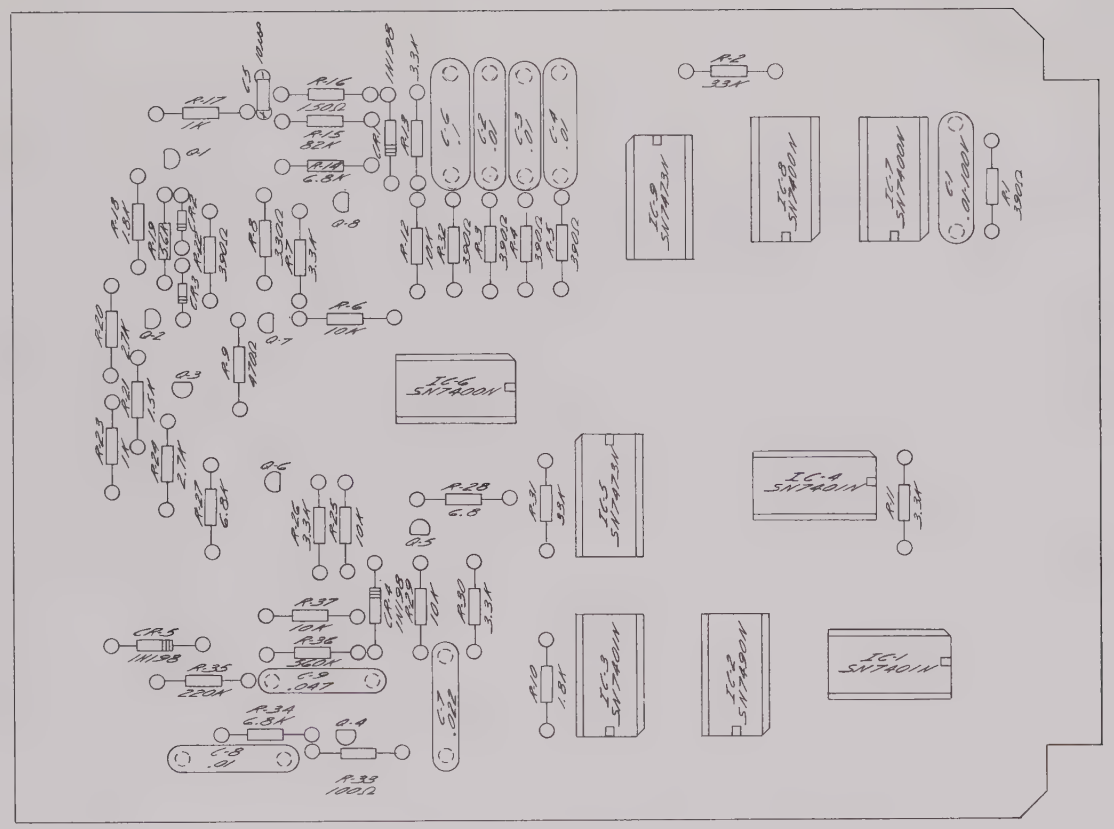
P.C. Bd. Ass'y
E-95291

TTS-176



NOTES:
1. All resistors 1/4w 10% carbon
2. All transistors MPS6515
3. All capacitors 225P

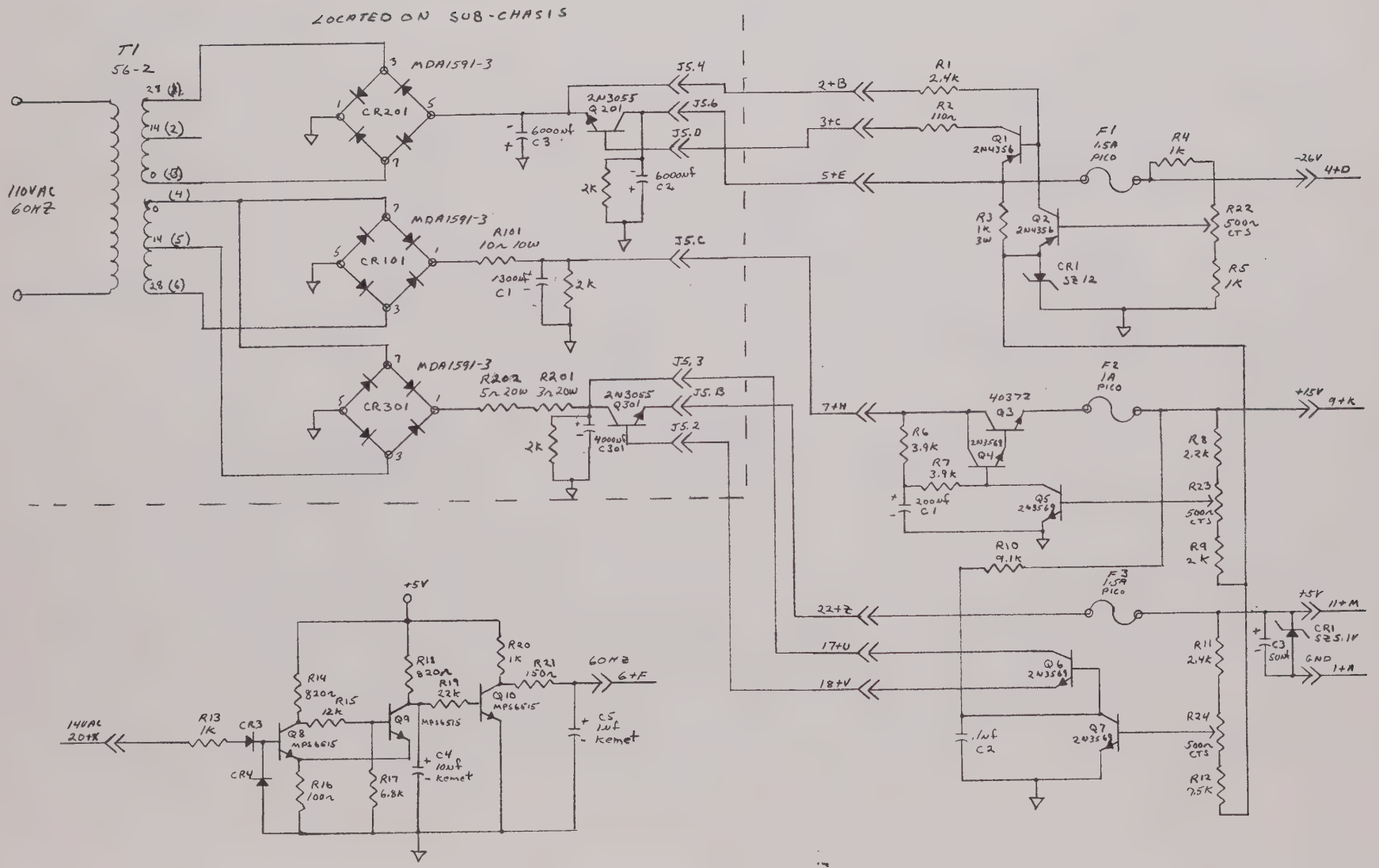
T/D CONTROL + DIAL PULSING
E95292
CARD 4



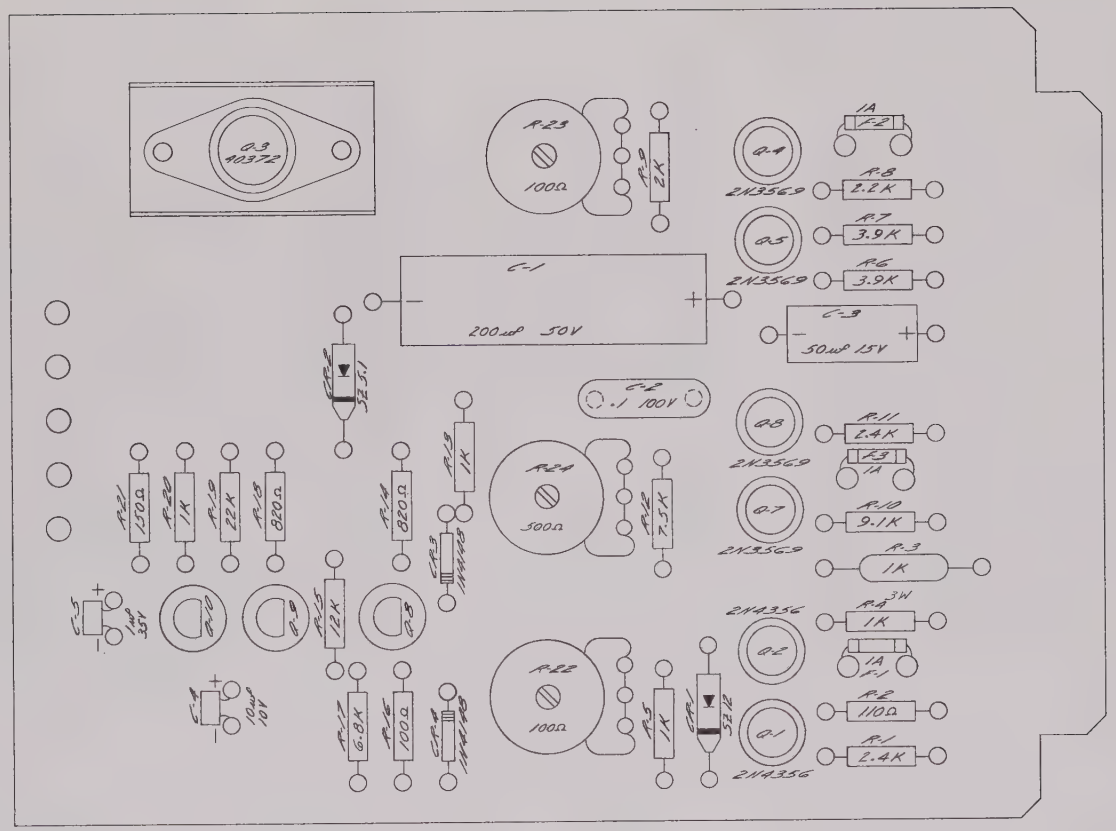
NOTES
CR2 & CR3 = 1N4148
ALL TRANSISTOR = MRS-6515

P.C. Bd. Assy
E-95292

TTS-176



POWER SUPPLY
E95293
CARD 11

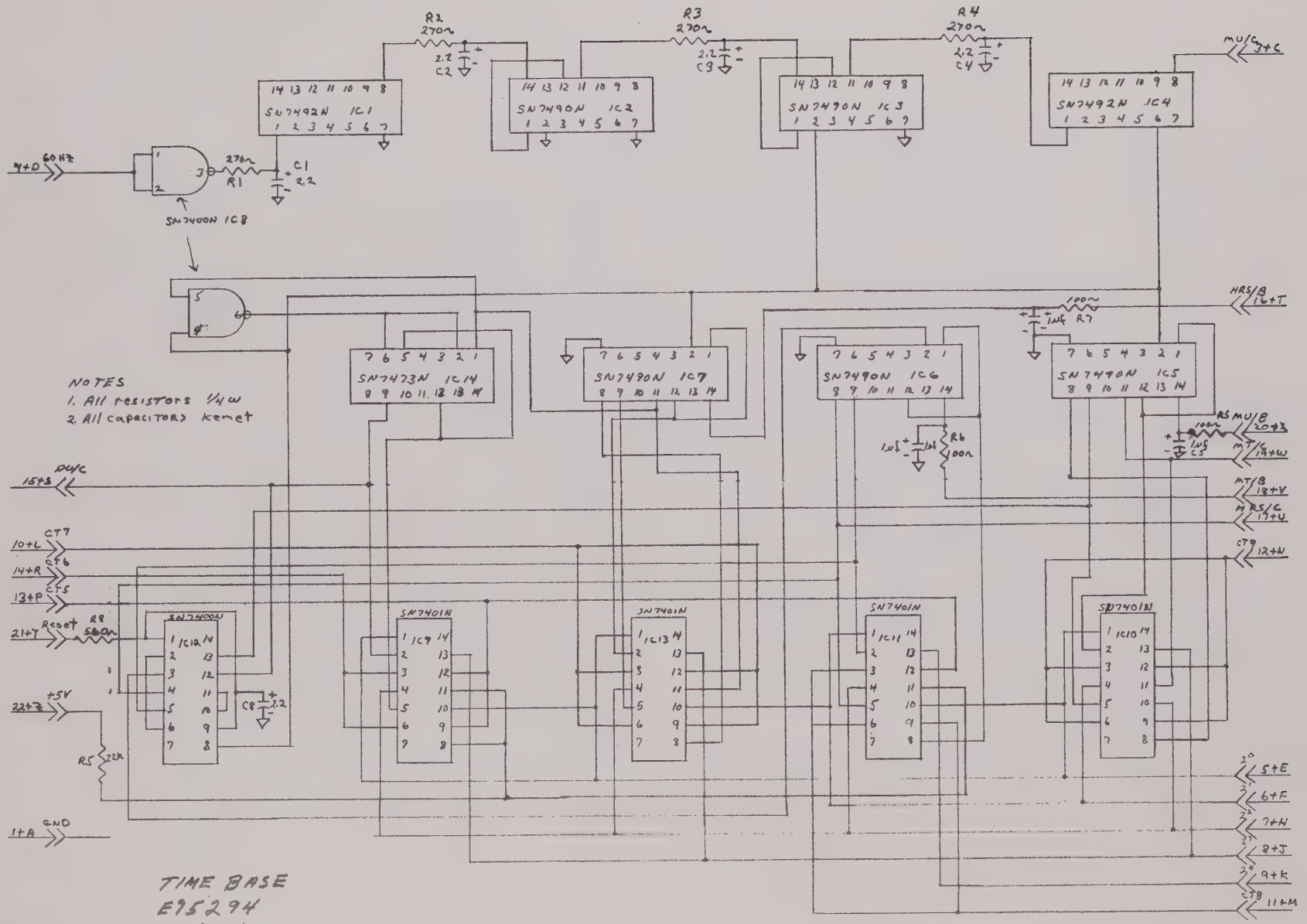


NOTES:

Q-8, Q-9 + Q-10 = MPS-6515

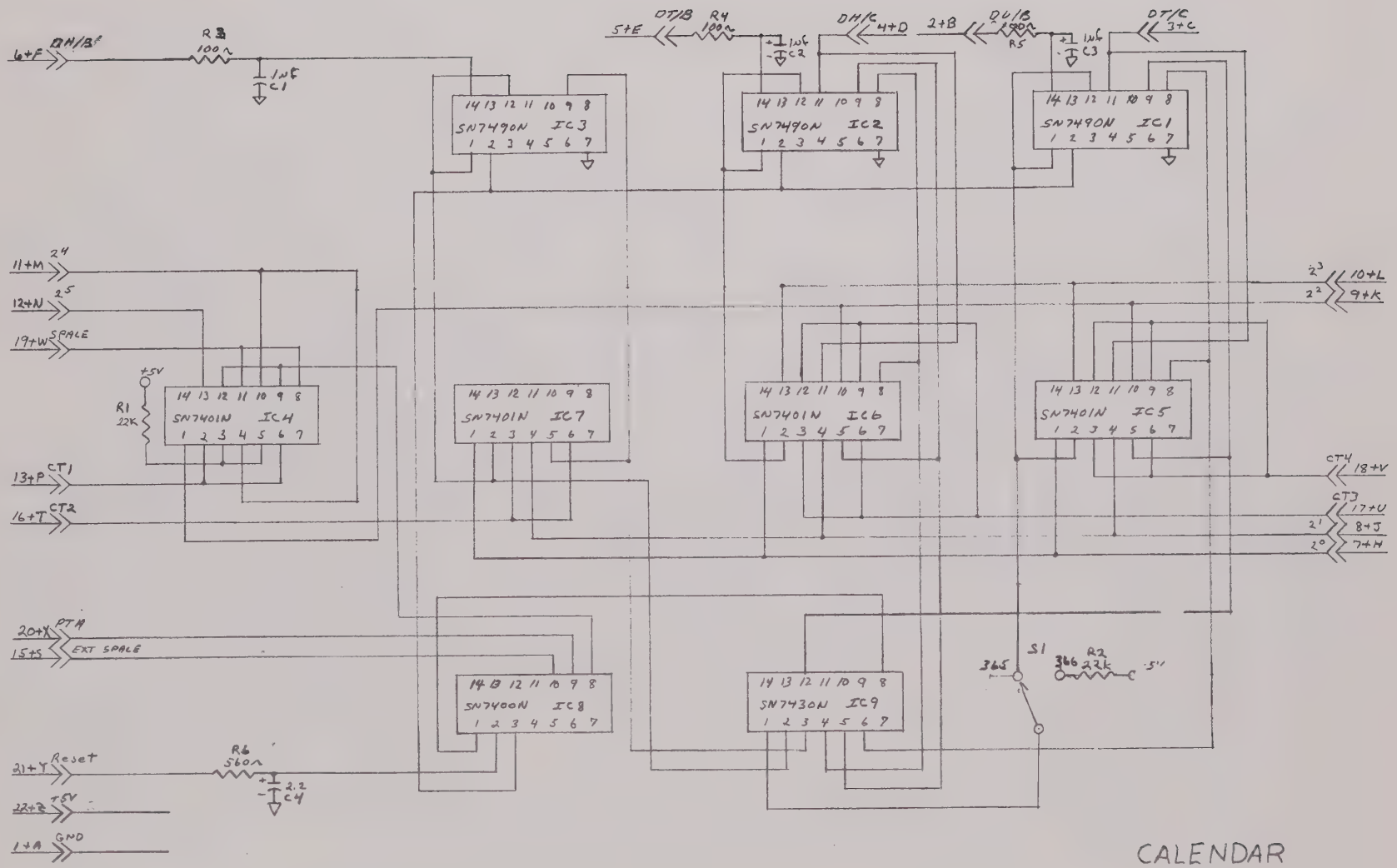
ASSEMBLY DIAGRAM
POWER SUPPLY
(E-95293)

TTS-176


R2 270Ω
R3 270Ω
R4 270Ω
2.2 C2
2.2 C3
2.2 C4
SN7492N IC1
SN7490N IC2
SN7490N IC3
SN7492N IC4
4+D 60 HZ
270Ω R1
C1 2.2
SN7400N IC8
100Ω 1μf R7
SN7473N IC14
SN7490N IC7
SN7490N IC6
SN7490N IC5
1μf C6
R6 100Ω
1μf C5
RS 100Ω
NOTES
1. All resistors 1/4 w
2. All capacitors Kemet
15+S
10+L
14+R
13+P
21+T
22+T
1+A
GND
+5V
Reset
R8 560Ω
C8 2.2
RS 22k
SN7400N IC12
SN7401N IC9
SN7401N IC13
SN7401N IC11
SN7401N IC10
5+E
6+F
7+H
8+J
9+K
11+M
TIME BASE
E95294
CARD 1
CARD 1

P.C. Bd Assy
E-9529A

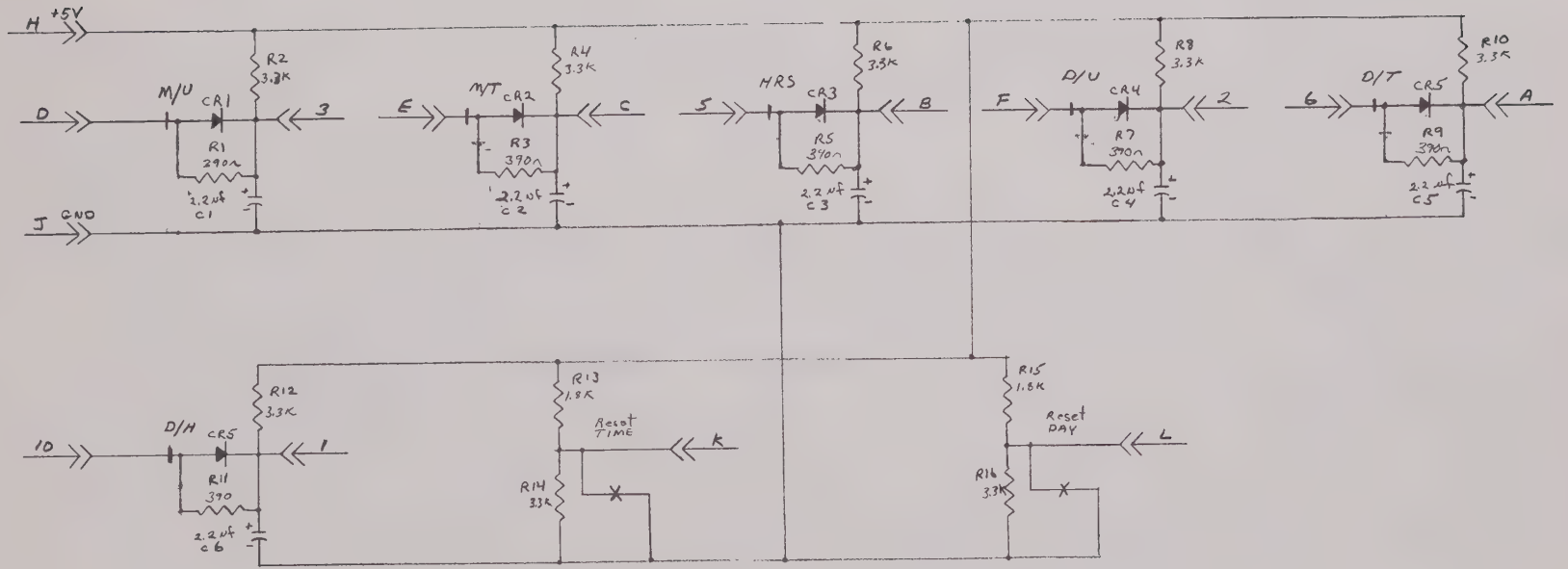
TTS-176



CALENDAR
E 95295
CARD 3

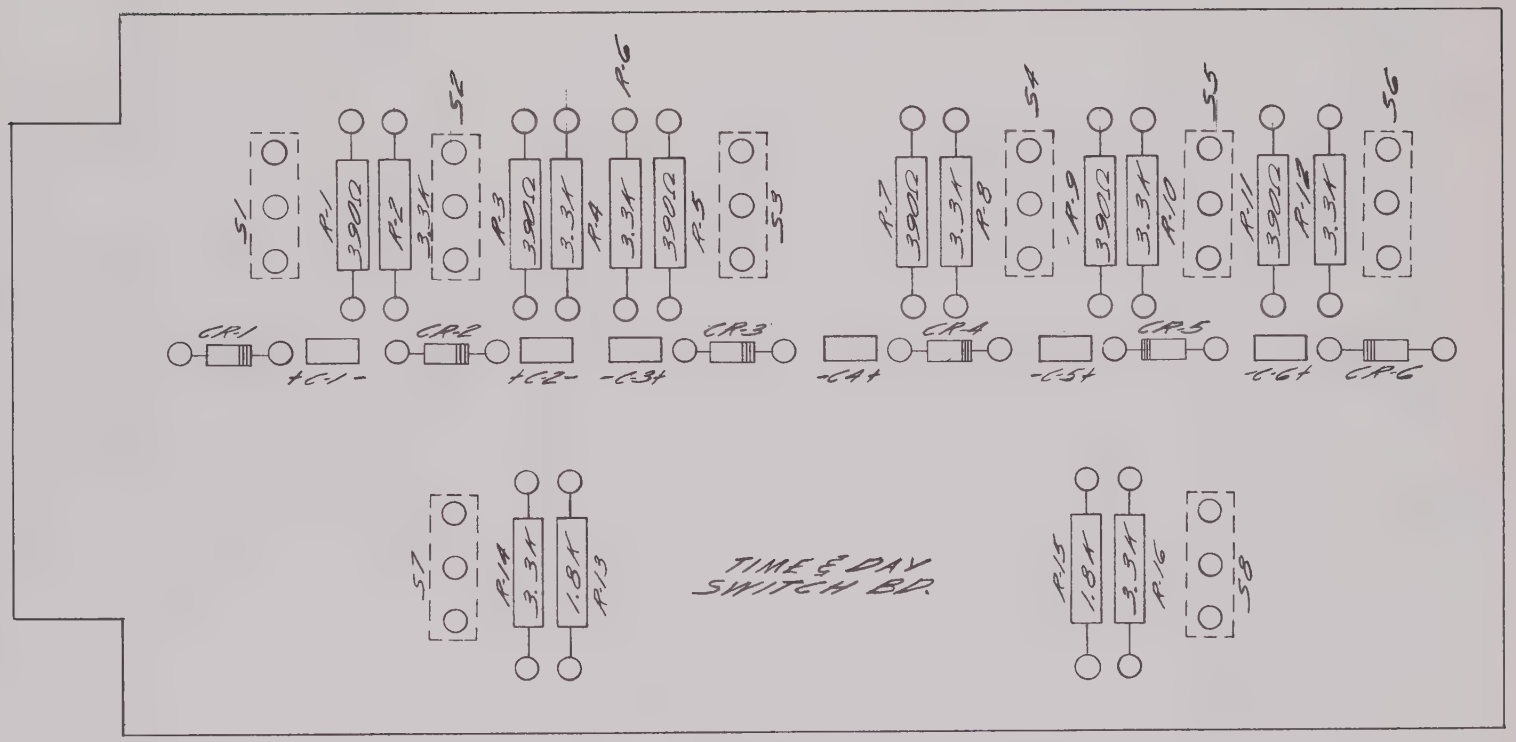
Fig. 2-11

Fig. 2-12 Assembly Diagram



NOTES:
1. All resistors ½w
2. All diodes IN4148
3. All capacitors kemet

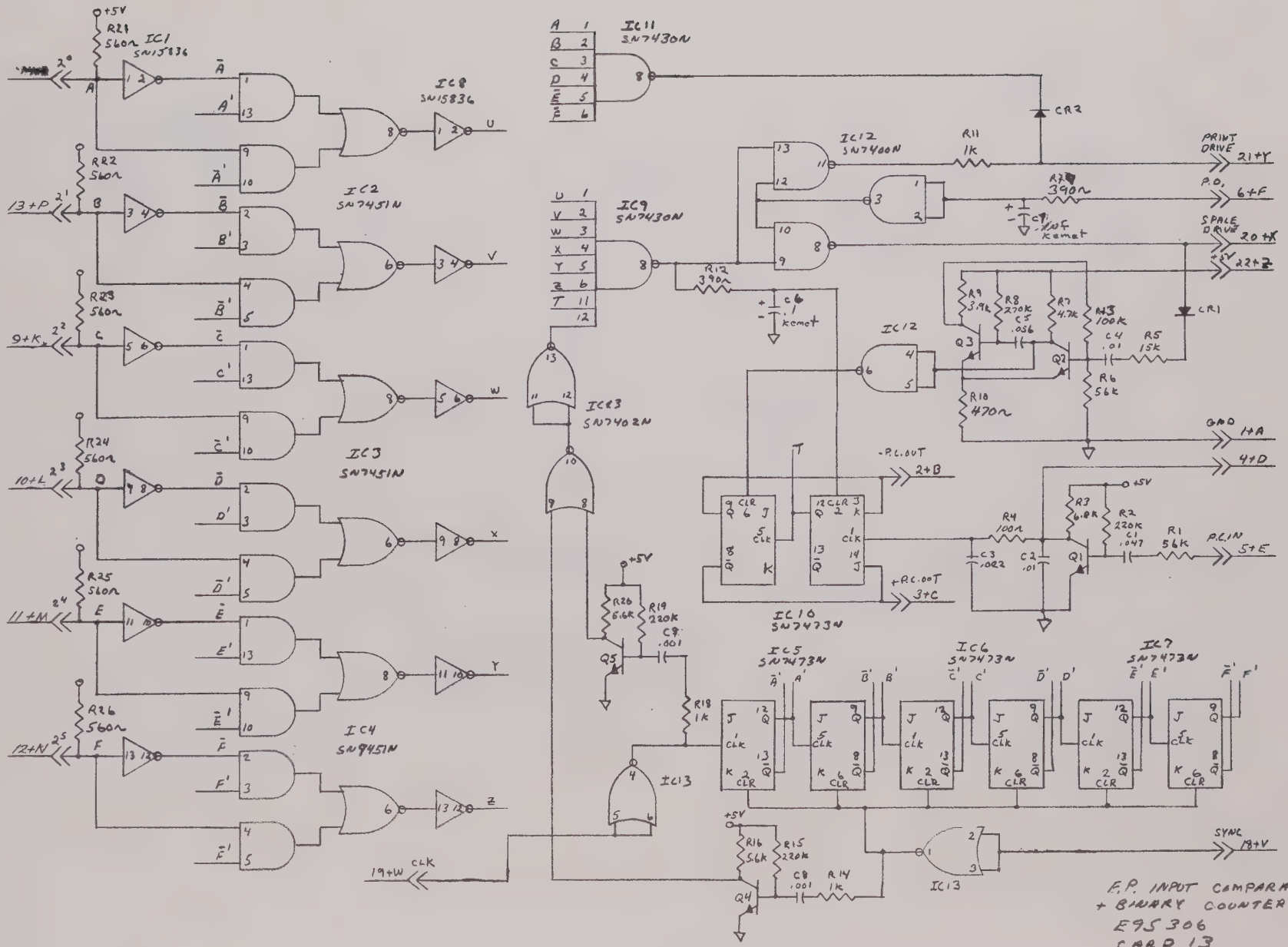
TIME + DAY
SWITCH BOARD
E95305

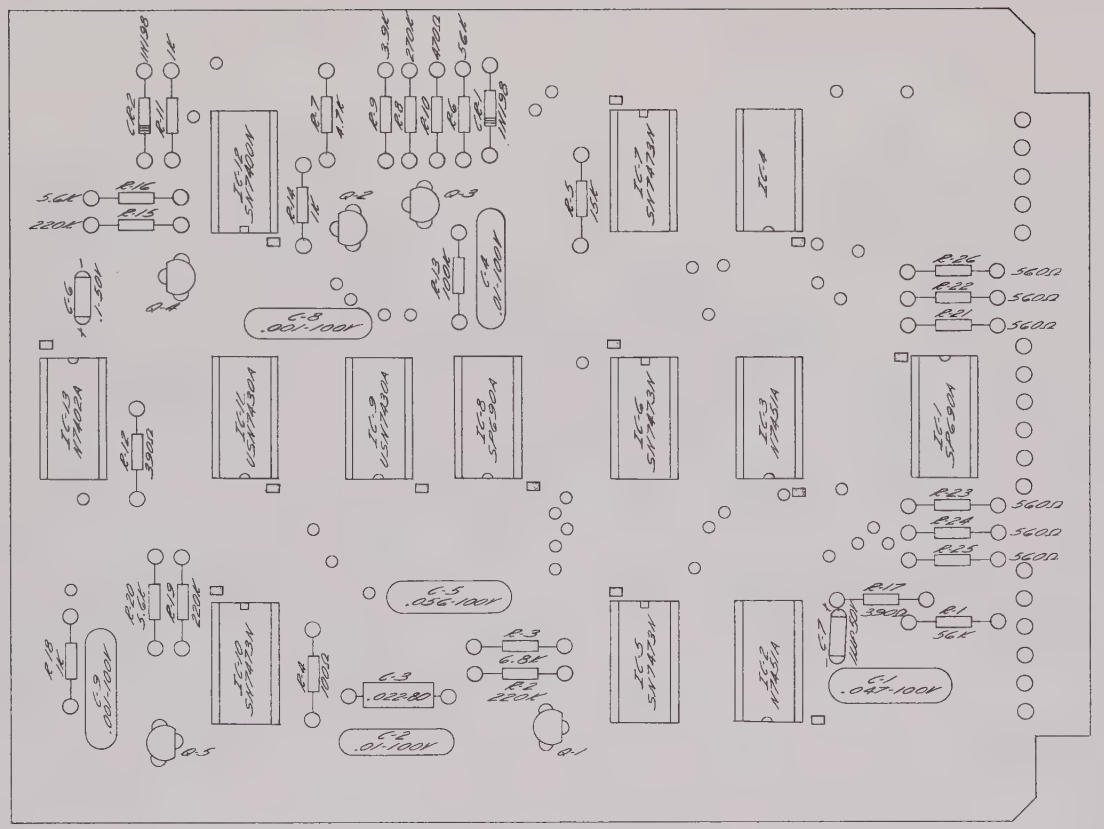


NOTES:
ALL DIODES = IN4148
ALL CAP. = KEMET 2.2
ALL SWITCHES = C&K 7109-PC
ALL RES. 1/2W CARBON

P.C. BD. ASS'Y
E-95305

TTS-176

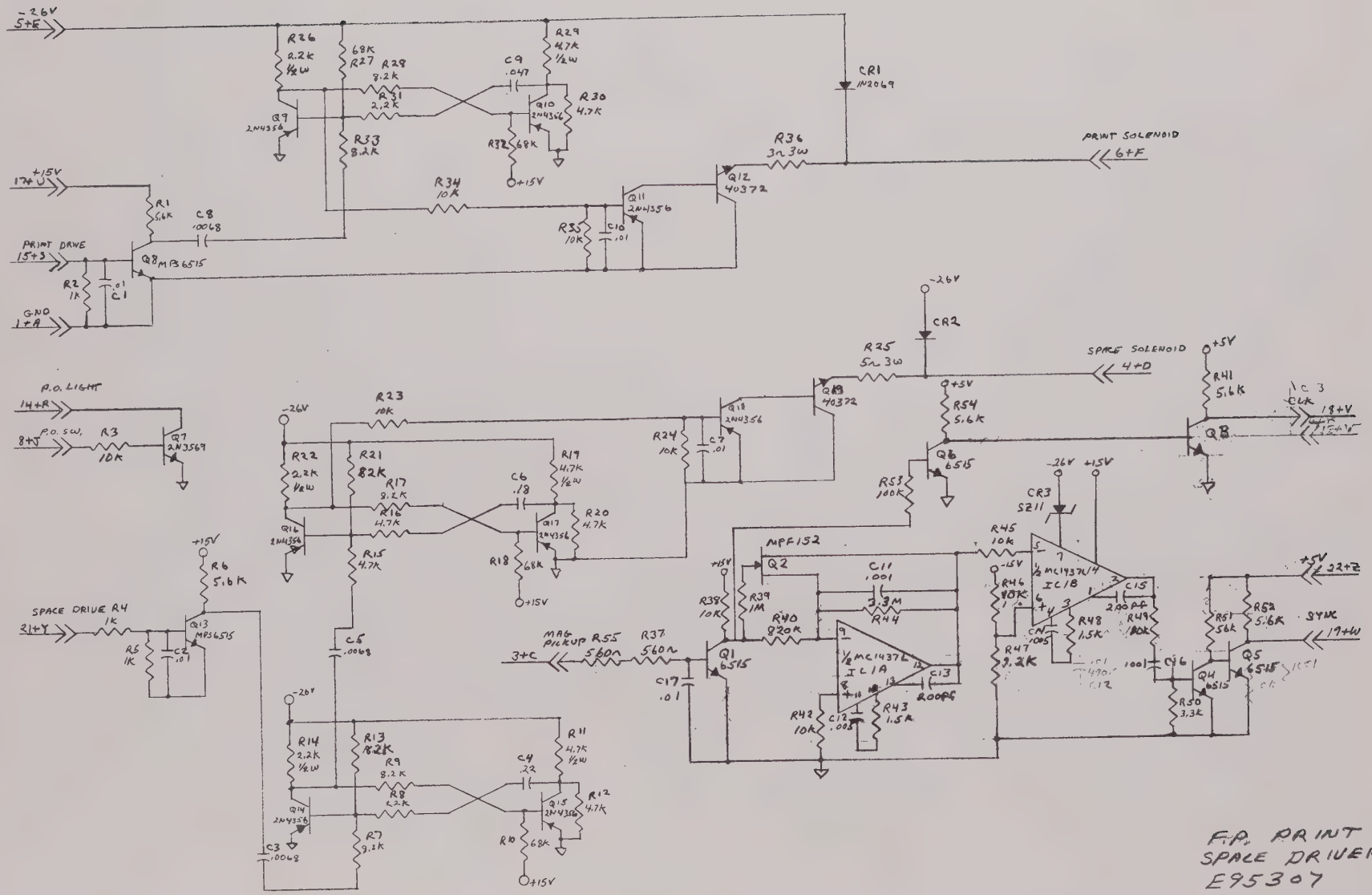

+5V
R21 560Ω
IC1 SN15836
IC8 SN15836
IC2 SN7451N
IC3 SN7451N
IC4 SN9451N
R22 560Ω
R23 560Ω
R24 560Ω
R25 560Ω
R26 560Ω
IC11 SN7430N
IC9 SN7430N
IC12 SN7400N
IC13 SN7402N
IC10 SN7473N
IC5 SN7473N
IC6 SN7473N
IC7 SN7473N
R11 1K
R12 390Ω
R13 390Ω
C9 .1MF kemet
C6 1 kemet
CR2
CR1
R9 3.9K
R8 270K
C5 .056
R7 4.7K
R3 100K
C4 .01
R5 15K
R6 56K
R10 470Ω
Q3
Q2
Q1
R4 100Ω
R7 6.8K
R2 220K
C1 .047
R1 56K
C3 .022
C2 .01
R26 6.8K
R19 220K
C9 .001
Q5
R18 1K
R16 5.6K
R15 220K
C8 .001
R14 1K
Q4
PRINT DRIVE 21+Y
P.O. 6+F
SPARE DRIVE 20+X
+5V 22+Z
GND 1+A
4+D
-P.C.OUT 2+B
+P.C.OUT 3+C
P.C.IN 5+E
SYNC 18+V
19+W CLK
13+P
9+K
10+L
11+M
12+N
E.P. INPUT COMPARATOR + BINARY COUNTER
E95306
CARD 13



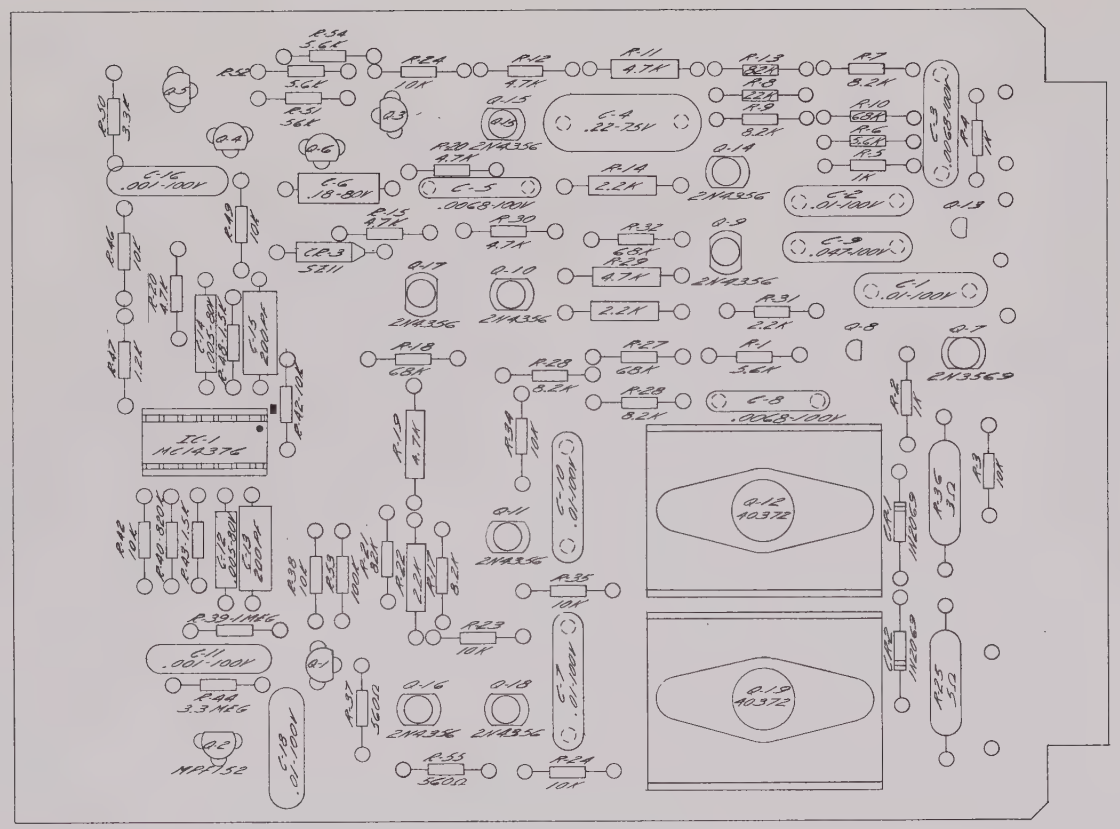
NOTE
ALL TRANSISTORS = NPS6515

P.C. Bd. Assembly
E-95306

TTS-176



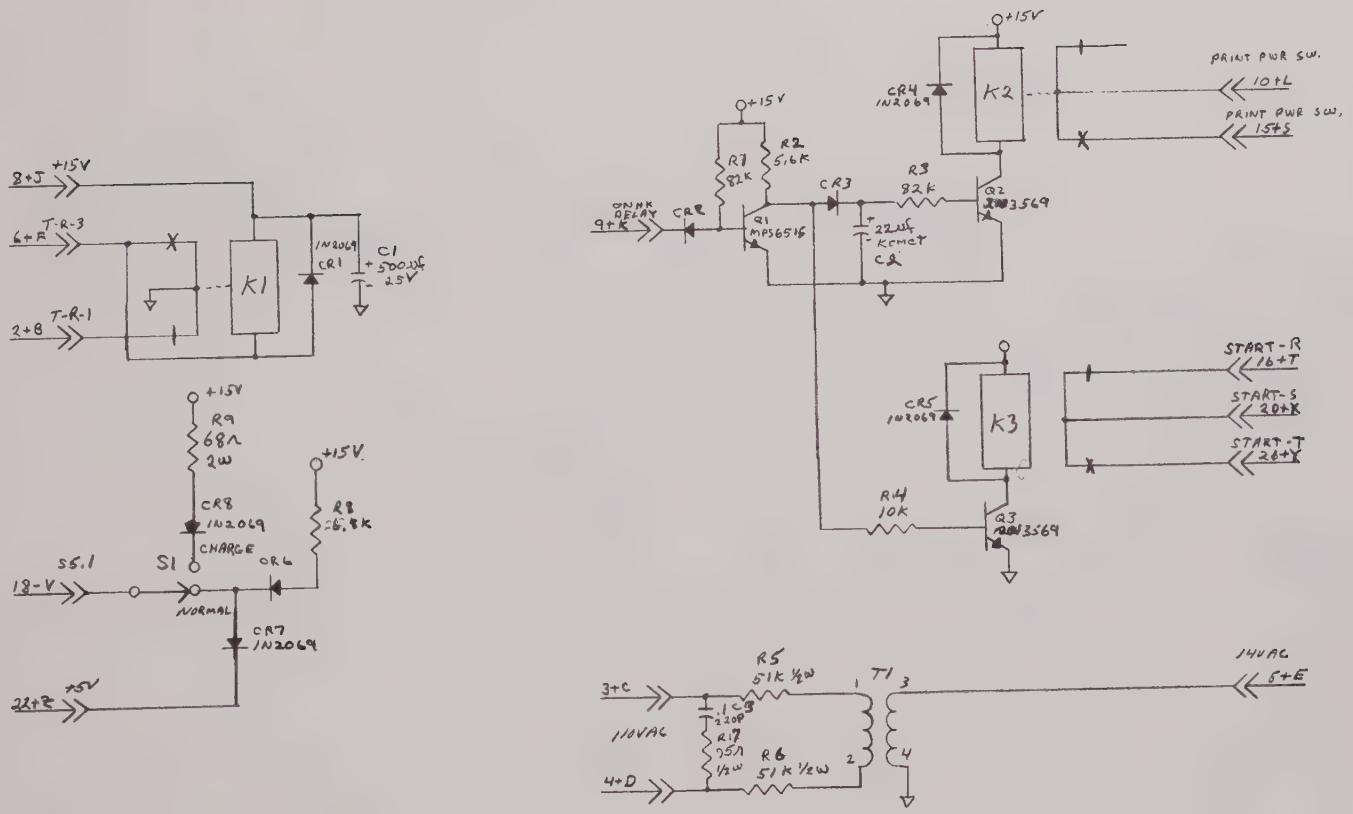
F.P. PRINT - SPACE DRIVER
E95307
CARD 12



ALL UNMARKED TRANSISTORS: MPS-6515

P.C. Bd. Ass'y
E-95307

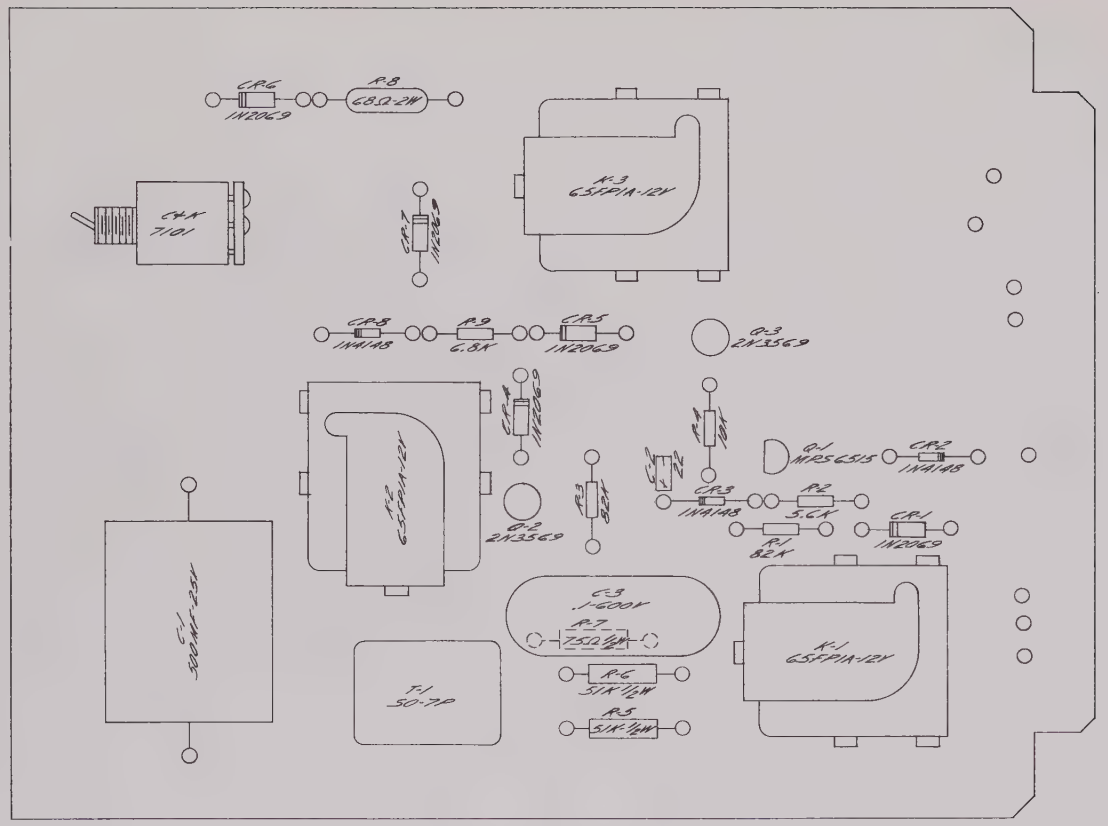
TTS-176



NOTES:

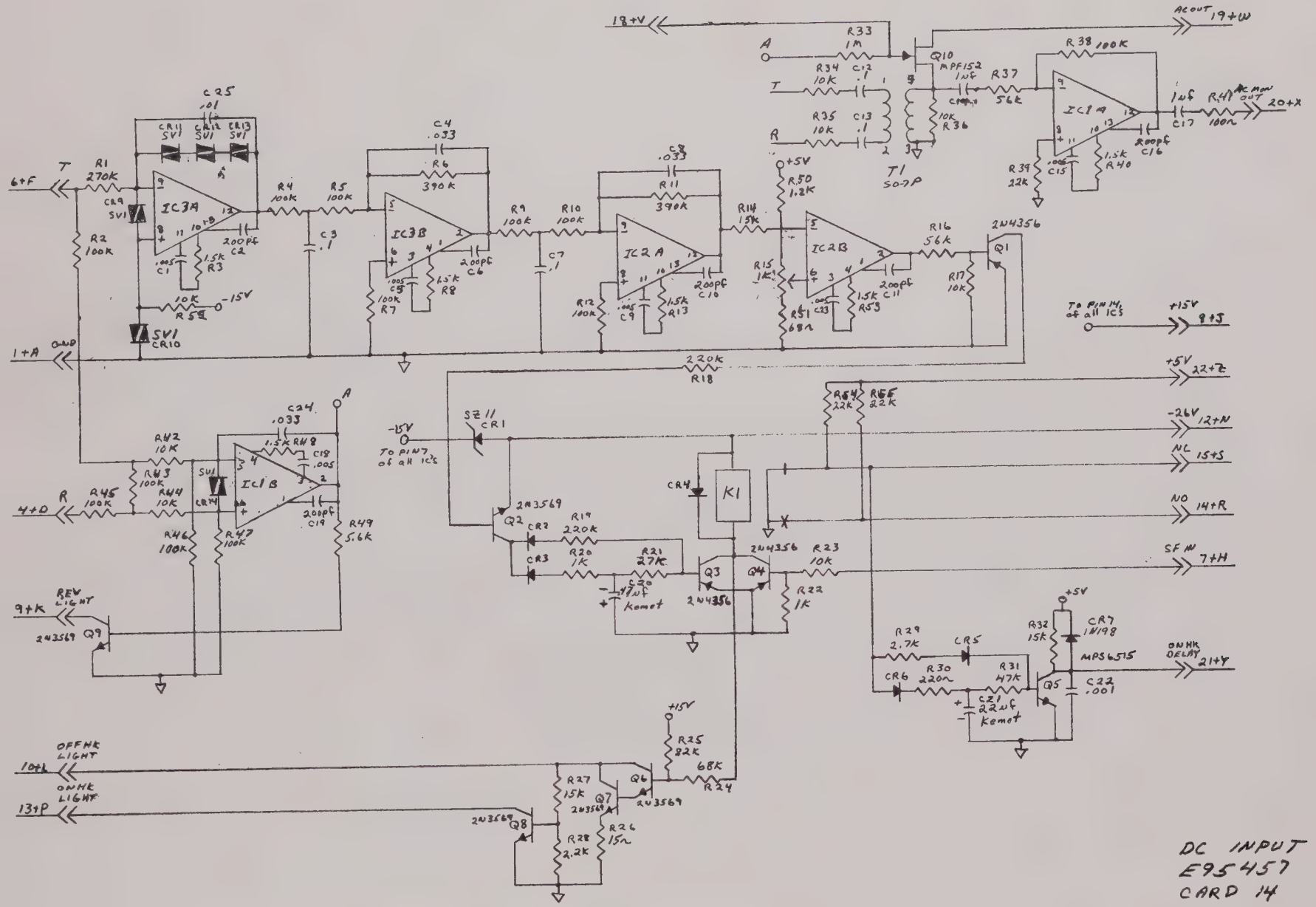
1. Relays are Sigma 65EP1A-12VDC
2. All unmarked diodes are 1N4148

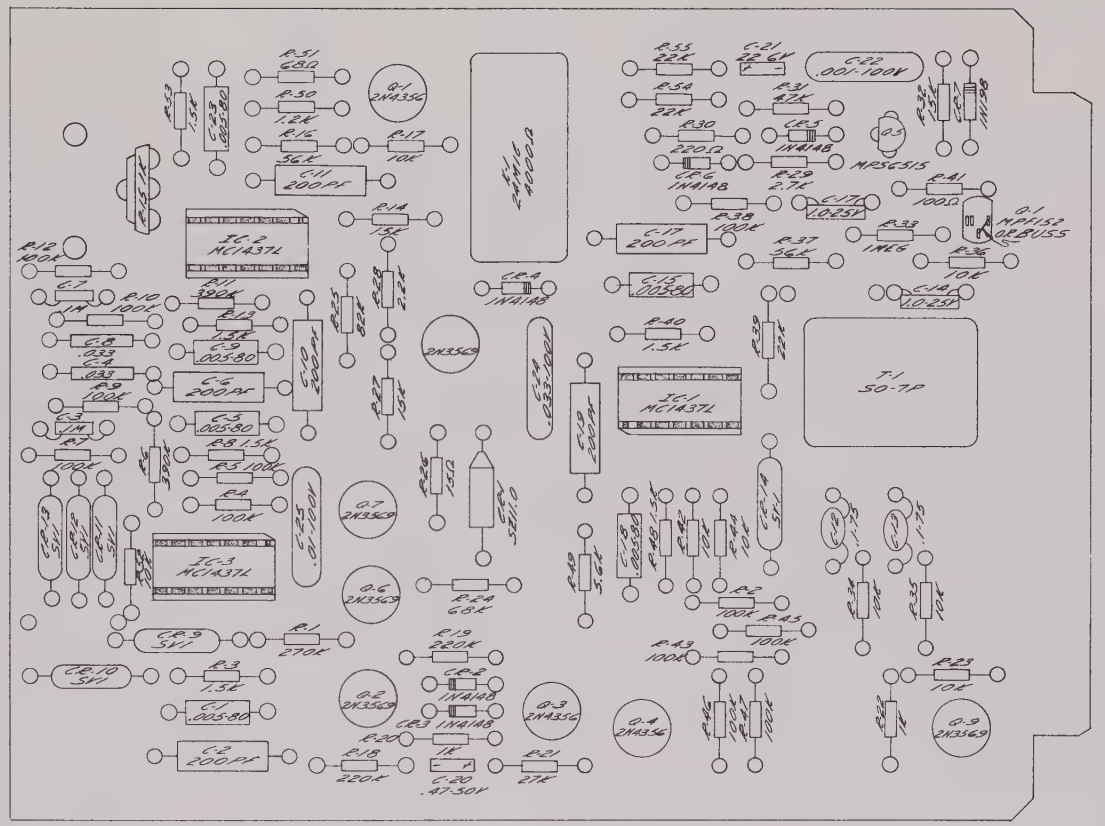
RELAY BOARD
E95407
CARD 16



P.C. Bd. Assy
E-95407

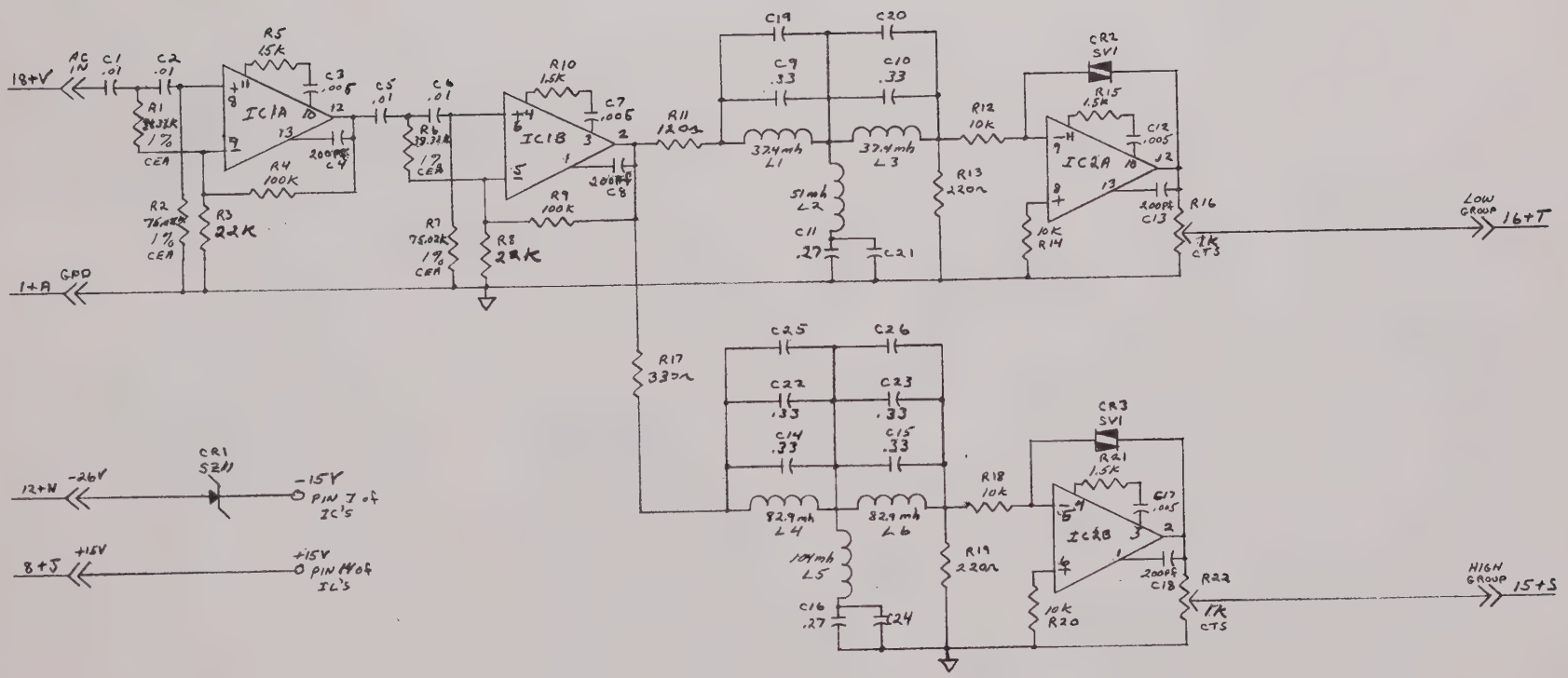
TTS-176


DC INPUT
E95457
CARD 14



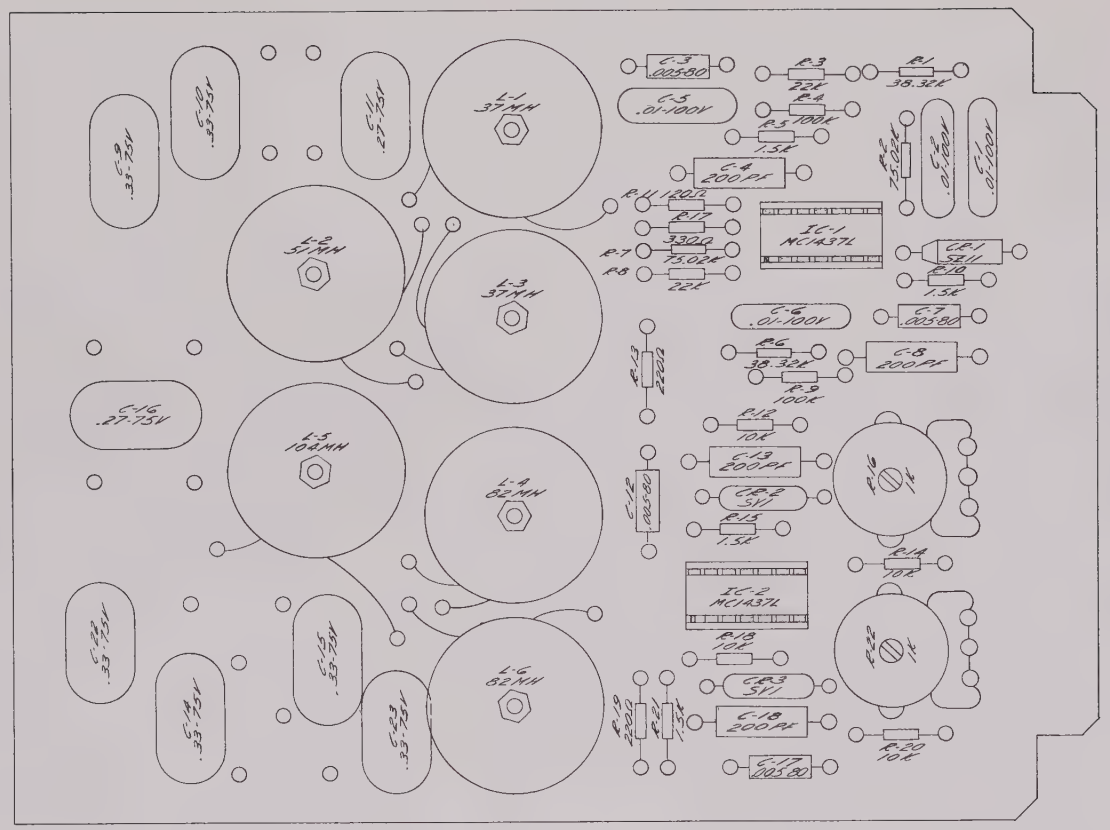
P.C. Bd. Assembly
E-95457

TTS-176



NOTES:
1. All IC's are MC14376
2. All resistors are 1/4W carbon 10% unless otherwise designated.
3. All capacitors are 225p except for C4, C8, C13 and C18 which are mica

AC INPUT
E95458
CARD 15



P.C. Bd. Assembly
E-95458

TTS-176

SECTION 6

ELECTRONIC PARTS LIST

6.1 INTRODUCTION. The following pages contain the parts list for the Model TTS 176.

6.2 FSCM Code Numbers. The Federal Supply Code of Manufacturers of each part. A list of these codes and their respective manufacturers is given below.

LIST OF MANUFACTURERS

Code No.	Manufacturer
01121	Allen Bradley
01295	Texas Instruments, Inc.
05397	Kemet
05844	Callins
06819	NEC
07716	IRC
09353	C&K
12065	Transitron
13606	Sprague
15873	Motorola
17803	Fairchild
44655	Ohmite Manufacturing Company
49671	RCA
71450	CTS
77342	Potter & Brumfield
75915	Littelfuse
80368	Sylvania
81081	Schauer Manufacturing Company
81095	Triad
83612	Kidde
84171	Arco
86080	CRL

E95290 - T. T. Register

Ref Desig.	Description	Manufacturer (FSCM Code #)	Part Number
C1	C: 0.047μF 100V	13606	225P
C2	C: 0.01μF 100V	13606	225P
C3	C: 0.022μF 100V	13606	225P
C4	C: 0.001μF 100V	13606	225P
C5	C: 0.047μF 100V	13606	225P
C6	C: 0.033μF 100V	13606	225P
C7	C: 0.022μF 100V	13606	225P
C8	C: 0.01μF 100V	13606	225P
C9	C: 0.047μF 100V	13606	225P
C10 and C11	C: 0.01μF 100V	86080	ID01
R1 and R2	R: 2.2K $\frac{1}{4}$W 10%	01121	RC07
R3	R: 10K $\frac{1}{4}$W 10%	01121	RC07
R4	R: 220K $\frac{1}{4}$W 10%	01121	RC07
R5	R: 560K $\frac{1}{4}$W 10%	01121	RC07
R6	R: 6.8K $\frac{1}{4}$W 10%	01121	RC07
R7	R: 100Ω $\frac{1}{4}$W 10%	01121	RC07
R8	R: 15K $\frac{1}{4}$W 10%	01121	RC07
R9	R: 8.2K $\frac{1}{4}$W 10%	01121	RC07
R10 and R11	R: 1K $\frac{1}{4}$W 10%	01121	RC07
R12	R: 100Ω $\frac{1}{4}$W 10%	01121	RC07
R13	R: 39K $\frac{1}{4}$W 10%	01121	RC07
R14	R: 2.2K $\frac{1}{4}$W 10%	01121	RC07
R15	R: 100Ω $\frac{1}{4}$W 10%	01121	RC07
R16	R: 6.8K $\frac{1}{4}$W 10%	01121	RC07
R17	R: 220K $\frac{1}{4}$W 10%	01121	RC07
R18	R: 560K $\frac{1}{4}$W 10%	01121	RC07
R19	R: 10K $\frac{1}{4}$W 10%	01121	RC07
R20	R: 180K $\frac{1}{4}$W 10%	01121	RC07
R21	R: 22K $\frac{1}{4}$W 10%	01121	RC07
Q1 thru Q5	Transistors: NPN silicon	15873	MPS6515
CR1 thru CR8	Diodes	80368	1N198
IC1 thru IC3	Integrated circuits	01295	SN7473N
IC4 and IC5	Integrated circuits	01295	SN7401N
IC6	Integrated circuit	01295	SN7400N
IC7 thru IC9	Integrated circuits	01295	SN7473N
IC10 thru IC12	Integrated circuits	01295	SN7401N

E95291 - P.C. & Shift

Ref Desig.	Description	Manufacturer (FSCM Code #)	Part Number
C1	C: 0.01μF 100V	13606	225P
C2	C: 0.001μF 100V	13606	225P
C3	C: 0.082μF 100V	13606	225P
C4	C: 0.056μF 100V	13606	225P
C5	C: 0.001μF 100V	13606	225P
R1	R: 1M $\frac{1}{4}$W 10%	01121	RC07
R2	R: 2.7K $\frac{1}{4}$W 10%	01121	RC07
R3 and R4	R: 100Ω $\frac{1}{4}$W 10%	01121	RC07
R5	R: 8.2K $\frac{1}{4}$W 10%	01121	RC07
R6	R: 1K $\frac{1}{4}$W 10%	01121	RC07
R7	R: 6.8K $\frac{1}{4}$W 10%	01121	RC07
R8	R: 680K $\frac{1}{4}$W 10%	01121	RC07
R9	R: 4.7K $\frac{1}{4}$W 10%	01121	RC07
R10	R: 10K $\frac{1}{4}$W 10%	01121	RC07
R11	R: 1M $\frac{1}{4}$W 10%	01121	RC07
R12	R: 180K $\frac{1}{4}$W 10%	01121	RC07
R13	R: 10K $\frac{1}{4}$W 10%	01121	RC07
R14	R: 22K $\frac{1}{4}$W 10%	01121	RC07
R15	R: 4.7K $\frac{1}{4}$W 10%	01121	RC07
R16	R: 270Ω $\frac{1}{4}$W 10%	01121	RC07
R17	R: 1K $\frac{1}{4}$W 10%	01121	RC07
Q1 thru Q4	Transistors: NPN	15873	MPS6515
CR1 thru CR4	Diodes	80368	1N198
IC1 and IC2	Integrated circuits	01295	SN7420N
IC3	Integrated circuit	01295	SN7410N
IC4	Integrated circuit	01295	SN7420N
IC5 and IC6	Integrated circuits	01295	SN7473N
IC7	Integrated circuit	01295	SN7410N
IC8	Integrated circuit	01295	SN7400N
IC9	Integrated circuit	15873	MC789P
IC10	Integrated circuit	01295	SN7401N
IC11	Integrated circuit	01295	SN7400N

E95292 - T/D Control & Dial Pulsing

Ref Desig.	Description	Manufacturer (FSCM Code #)	Part Number
C1	C: 0.1μF 100V	13606	225P
C2 thru C4	C: 0.01μF 100V	13606	225P
C5	C: 10μF 10V	05397	K10W10K
C6	C: 0.01μF 100V	13606	225P
C7	C: 0.022μF 100V	13606	225P
C8	C: 0.01μF 100V	13606	225P
C9	C: 0.047μF 100V	13606	225P
C10	C: 0.01μF 100V	86080	ID01
R1	R: 390Ω ¼W 10%	01121	RC07
R2	R: 33K ¼W 10%	01121	RC07
R3 thru R5	R: 390Ω ¼W 10%	01121	RC07
R6	R: 10K ¼W 10%	01121	RC07
R7	R: 560K ¼W 10%	01121	RC07
R8	R: 6.8K ¼W 10%	01121	RC07
R9	R: 10K ¼W 10%	01121	RC07
R10	R: 1.8K ¼W 10%	01121	RC07
R11	R: 3.3K ¼W 10%	01121	RC07
R12	R: 10K ¼W 10%	01121	RC07
R13	R: 3.3K ¼W 10%	01121	RC07
R14	R: 6.8K ¼W 10%	01121	RC07
R15	R: 82K ¼W 10%	01121	RC07
R16	R: 150Ω ¼W 10%	01121	RC07
R17	R: 1K ¼W 10%	01121	RC07
R18	R: 1.8K ¼W 10%	01121	RC07
R19	R: 5.6K ¼W 10%	01121	RC07
R20	R: 2.7K ¼W 10%	01121	RC07
R21	R: 1.5K ¼W 10%	01121	RC07
R22	R: 390Ω ¼W 10%	01121	RC07
R23	R: 1K ¼W 10%	01121	RC07
R24	R: 2.7K ¼W 10%	01121	RC07
R25	R: 10K ¼W 10%	01121	RC07
R26	R: 3.3K ¼W 10%	01121	RC07
R27 and R28	R: 6.8K ¼W 10%	01121	RC07
R29	R: 10K ¼W 10%	01121	RC07
R30	R: 3.3K ¼W 10%	01121	RC07
R31	R: 33K ¼W 10%	01121	RC07
R32	R: 390Ω ¼W 10%	01121	RC07
R33	R: 100Ω ¼W 10%	01121	RC07
R34	R: 6.8K ¼W 10%	01121	RC07
R35	R: 100K ¼W 10%	01121	RC07
IC1	Integrated circuit	01295	SN7401N
IC2	Integrated circuit	01295	SN7490N
IC3 and IC4	Integrated circuits	01295	SN7401N

E95292 - T/D Control & Dial Pulsing (cont.)

Ref Desig.	Description	Manufacturer (FSCM Code #)	Part Number
IC5	Integrated circuit	01295	SN7473N
IC6 thru IC8	Integrated circuits	01295	SN7400N
IC9	Integrated circuit	01295	SN7473N
Q1 thru Q8	Transistors: NPN silicon	15873	MPS6515
CR1	Diode	80368	1N198
CR2 and CR3	Diodes	12065	1N4148
CR4 and CR5	Diodes	80368	1N198

PC Board E95293

Ref Desig.	Description	Manufacturer (FSCM Code #)	Part Number
C1	C: 200μF 50V	05844	9-65PSD200-50
C2	C: 0.1μF 100V	13606	225PW
C3	C: 50μF 15V	13606	TE1160
C4	C: 10μF 10V	05397	K10W10K
C5	C: 1.0μF 50V	05397	K1W50K
R1	R: 2.4K ½W 5%	01121	
R2	R: 110Ω ½W 5%	01121	
R3	R: 1K 3W blue jacket	13606	
R4 and R5	R: 1K ½W 5%	44655	
R6 and R7	R: 3.9K ½W 5%	44655	
R8	R: 2.2K ½W 5%	01121	
R9	R: 2K ½W 5%	01121	
R10	R: 9.1K ½W 5%	01121	
R11	R: 2.4K ½W 5%	01121	
R12	R: 7.5K ½W 5%	01121	
R13	R: 1K ½W 5%	01121	
R14	R: 820Ω ½W 5%	01121	
R15	R: 12K ½W 5%	01121	
R16	R: 100Ω ½W 5%	01121	
R17	R: 6.8K ½W 5%	01121	
R18	R: 820Ω ½W 5%	01121	
R19	R: 22K ½W 5%	01121	
R20	R: 1K ½W 5%	01121	
R21	R: 150Ω ½W 5%	01121	
R22 and R24	Pots: 500Ω	71450	SQ8514
CR1	Diode	81071	SZ12V
CR2	Diode	81071	SZ5.1V
CR3 and CR4	Diodes	12065	1N4148
F1 thru F3	Fuses: 1.5A pico	75915	27601.5
F2	Fuse: 1A Pico	75915	27601
Q1 and Q2	Transistors: PNP silicon	17803	2N4356
Q3	Transistor: NPN silicon	49671	40372
Q4 thru Q7	Transistors: NPN	17803	2N3569
Q8 thru Q10	Transistors: NPN	15873	MPS6515

E95294 - Time Base

Ref Desig.	Description	Manufacturer (FSCM Code #)	Part Number
C1 thru C4	C: 2.2μF 25V	05397	K2R2W25K
C5 thru C7	C: 1μF 50V	05397	K1W50K
C8	C: 2.2μF 25V	05397	K2R2W25K
R1 thru R4	R: 270Ω $\frac{1}{4}$W 10%	01121	RC07
R5	R: 22K $\frac{1}{4}$W 10%	01121	RC07
R6 and R7	R: 100Ω $\frac{1}{4}$W 10%	01121	RC07
R8	R: 560Ω $\frac{1}{4}$W 10%	01121	RC07
R9	R: 100Ω $\frac{1}{4}$W 10%	01121	RC07
IC1	Integrated circuit	01295	SN7492N
IC2 and IC3	Integrated circuits	01295	SN7490N
IC4	Integrated circuit	01295	SN7492N
IC5 and IC7	Integrated circuits	01295	SN7490N
IC8	Integrated circuit	01295	SN7400N
IC9 thru IC11	Integrated circuits	01295	SN7401N
IC12	Integrated circuit	01295	SN7400N
IC13	Integrated circuit	01295	SN7401N
IC14	Integrated circuit	01295	SN7473N

E95295 - Calendar

C1 thru C3	C: 1μF 50V	05397	K1W50K
C4	C: 2.2μF 25V	05397	K2R2W25K
R1 and R2	R: 22K $\frac{1}{4}$W 10%	01121	RC07
R3 thru R5	R: 100Ω $\frac{1}{4}$W 10%	01121	RC07
R6	R: 560Ω $\frac{1}{4}$W 10%	01121	RC07
S1	S:	09353	7109
IC1 thru IC3	Integrated circuits	01295	SN7490N
IC4 thru IC7	Integrated circuits	01295	SN7401N
IC8	Integrated circuit	01295	SN7400N
IC9	Integrated circuit	01295	SN7430N

PC Board E95305

Ref Desig.	Description	Manufacturer (FSCM Code #)	Part Number
C1 thru C6	C: 2.2μF 35V	05397	K2R2W35K
R1	R: 390Ω ½W 10%	01121	
R2	R: 3.3K ½W 10%	01121	
R3	R: 390Ω ½W 10%	01121	
R4	R: 3.3K ½W 10%	01121	
R5	R: 390Ω ½W 10%	01121	
R6	R: 3.3K ½W 10%	01121	
R7	R: 390Ω ½W 10%	01121	
R8	R: 3.3K ½W 10%	01121	
R9	R: 390Ω ½W 10%	01121	
R10	R: 3.3K ½W 10%	01121	
R11	R: 390Ω ½W 10%	01121	
R12	R: 3.3K ½W 10%	01121	
R13	R: 1.8K ½W 10%	01121	
R14	R: 3.3K ½W 10%	01121	
R15	R: 1.8K ½W 10%	01121	
R16	R: 3.3K ½W 10%	01121	
S1 thru S8	S:	09353	7109
CR1 thru CR6	Diodes	12065	1N4148

E95306 - F.P. Comparator & Binary Counter

Ref Desig.	Description	Manufacturer (FSCM Code #)	Part Number
C1	C: 0.047μF 100V	13606	225PW
C2	C: 0.01μF 100V	13606	225PW
C3	C: 0.022μF 100V	13606	225PW
C4	C: 0.01μF 100V	13606	225PW
C5	C: 0.056μF 100V	13606	225PW
C6	C: 0.1μF	05397	KR1W
C7	C: 1μF	05397	K1W
C8 and C9	C: 0.001μF 100V	13606	225PW
R1	R: 56K ¼W 10%	01121	RC07
R2	R: 220K ¼W 10%	01121	RC07
R3	R: 6.8K ¼W 10%	01121	RC07
R4	R: 100Ω ¼W 10%	01121	RC07
R5	R: 15K ¼W 10%	01121	RC07
R6	R: 56K ¼W 10 %	01121	RC07
R7	R: 4.7K ¼W 10%	01121	RC07
R8	R: 270K ¼W 10%	01121	RC07
R9	R: 3.9K ¼W 10%	01121	RC07
R10	R: 470K ¼W 10%	01121	RC07
R11	R: 1K ¼W 10%	01121	RC07
R12	R: 390K ¼W 10%	01121	RC07
R13	R: 100K ¼W 10%	01121	RC07
R14	R: 1K ¼W 10%	01121	RC07
R15	R: 220K ¼W 10%	01121	RC07
R16	R: 5.6K ¼W 10%	01121	RC07
R17	R: 390K ¼W 10%	01121	RC07
R18	R: 1K ¼W 10%	01121	RC07
R19	R: 220K ¼W 10%	01121	RC07
R20	R: 5.6K ¼W 10%	01121	RC07
R21 thru R26	R: 560Ω ¼W 10%	01121	RC07
R27	R: 100K ¼W 10%	01121	RC07
R28	R: 390Ω ¼W 10%	01121	RC07
Q1 thru Q5	Transistors: NPN silicon	15873	MPS6515
CR1 and CR2	Diodes	80368	1N198
IC1	Integrated circuit	01295	SN15836N
IC2 thru IC4	Integrated circuits	01295	SN7451N
IC5 thru IC7	Integrated circuits	01295	SN7473N
IC8	Integrated circuit	01295	SN15836N
IC9	Integrated circuit	01295	SN7430N
IC10	Integrated circuit	01295	SN7473N
IC11	Integrated circuit	01295	SN7430N
IC12	Integrated circuit	01295	SN7400N
IC13	Integrated circuit	01295	SN7402N

E95307 - F.P. Print Space Driver

Ref Desig.	Description	Manufacturer (FSCM Code #)	Part Number
C1 and C2	C: 0.01μF 100V	13606	225P
C3	C: 0.0068μF 100V	13606	225P
C4	C: 0.22μF 100V	13606	225P
C5	C: 0.0068μF 100V	13606	225P
C6	C: 0.18μF 100V	13606	225P
C7	C: 0.01μF 100V	13606	225P
C8	C: 0.0068μF 100V	13606	225P
C9	C: 0.047μF 100V	13606	225P
C10	C: 0.01μF 100V	13606	225P
C11	C: 0.001μF 100V	13606	225P
C12	C: 0.005μF 100V	13606	225P
C13	C: 200pf	84171	CM15E200J
C14	C: 0.005μF 100V	13606	225P
C15	C: 200pf	84171	CM15E200J
C16	C: 0.001μF 100V	13606	225P
R1	R: 5.6K $\frac{1}{4}$W 10%	01121	RC07
R2	R: 1K $\frac{1}{4}$W 10%	01121	RC07
R3	R: 10K $\frac{1}{4}$W 10%	01121	RC07
R4 and R5	R: 1K $\frac{1}{4}$W 10%	01121	RC07
R6	R: 5.6K $\frac{1}{4}$W 10%	01121	RC07
R7	R: 8.2K $\frac{1}{4}$W 10%	01121	RC07
R8	R: 22K $\frac{1}{4}$W 10%	01121	RC07
R9	R: 8.2K $\frac{1}{4}$W 10%	01121	RC07
R10	R: 68K $\frac{1}{4}$W 10%	01121	RC07
R11 and R12	R: 4.7K $\frac{1}{4}$W 10%	01121	RC07
R13	R: 82K $\frac{1}{4}$W 10%	01121	RC07
R14	R: 2.2K $\frac{1}{4}$W 10%	01121	RC07
R15 and R16	R: 4.7K $\frac{1}{4}$W 10%	01121	RC07
R17	R: 8.2K $\frac{1}{4}$W 10%	01121	RC07
R18	R: 68K $\frac{1}{4}$W 10%	01121	RC07
R19 and R20	R: 4.7K $\frac{1}{4}$W 10%	01121	RC07
R21	R: 82K $\frac{1}{4}$W 10%	01121	RC07
R22	R: 2.2K $\frac{1}{4}$W 10%	01121	RC07
R23 and R24	R: 10K $\frac{1}{4}$W 10%	01121	RC07
R25	R: 5Ω 3W	13606	242E5R05
R26	R: 2.2K $\frac{1}{2}$W 5%	01121	RC20
R27	R: 68K $\frac{1}{4}$W 10%	01121	RC07
R28	R: 8.2K $\frac{1}{4}$W 10%	01121	RC07
R29 and R30	R: 4.7K $\frac{1}{4}$W 10%	01121	RC07
R31	R: 2.2K $\frac{1}{4}$W 10%	01121	RC07
R32	R: 68K $\frac{1}{4}$W 10%	01121	RC07
R33	R: 8.2K $\frac{1}{4}$W 10%	01121	RC07

E95307 - (Cont.)

Ref Desig.	Description	Manufacturer (FSCM Code #)	Part Number
R34 and R35	R: 10K $\frac{1}{4}$W 10%	01121	RC07
R36	R: 3Ω 3W	13606	242E3R05
R37	R: 1K $\frac{1}{4}$W 10%	01121	RC07
R38	R: 10K $\frac{1}{4}$W 10%	01121	RC07
R39	R: 1M $\frac{1}{4}$W 10%	01121	RC07
R40	R: 820K $\frac{1}{4}$W 10%	01121	RC07
R41	R: 5.6K $\frac{1}{4}$W 10 %	01121	RC07
R42	R: 10K $\frac{1}{4}$W 10%	01121	RC07
R43	R: 1.5K $\frac{1}{4}$W 10%	01121	RC07
R44	R: 3.3K $\frac{1}{4}$W 10%	01121	RC07
R45	R: 10K $\frac{1}{4}$W 10%	01121	RC07
R46 and R47	not used		
R48	R: 1.5K $\frac{1}{4}$W 10%	01121	RC07
R49	R: 10K $\frac{1}{4}$W 10%	01121	RC07
R50	R: 3.3K $\frac{1}{4}$W 10%	01121	RC07
R51	R: 56K $\frac{1}{4}$W 10%	01121	RC07
R52	R: 5.6K $\frac{1}{4}$W 10 %	01121	RC07
R53	R: 100K $\frac{1}{4}$W 10%	01121	RC07
R54	R: 5.6K $\frac{1}{4}$W 10%	01121	RC07
Q1	Transistor: NPN	15873	MPS6515
Q2	Transistor: P-Channel	15873	MPF152
Q3 thru Q6	Transistors: NPN	15873	MPS6515
Q7	Transistor: NPN	17803	2N3569
Q8	Transistor: NPN	15873	MPS6515
Q9 thru Q11	Transistors: PNP	17803	2N4356
Q12	Transistor: NPN	49671	40372
Q13	Transistor: NPN	15873	MPS6515
Q14 thru Q18	Transistors: PNP	17803	2N4356
Q19	Transistor: NPN	49671	40372
CR1 and CR2	Diodes	80368	1N2069
CR3	Diode	81071	SZ11
IC1	Integrated circuit	15873	MC1437L

E95407 - Relay Board

Ref Desig.	Description	Manufacturer (FSCM Code #)	Part Number
C1	C: 500μF 25V	13606	39D
C2	C: 22μF 6V	05397	K22W6K
C3	C: 0.1μF 600V	13606	6PS
R1	R: 82K $\frac{1}{4}$W 10%	01121	RC07
R2	R: 5.6K $\frac{1}{4}$W 10%	01121	RC07
R3	R: 82K $\frac{1}{4}$W 10%	01121	RC07
R4	R: 10K $\frac{1}{4}$W 10%	01121	RC07
R5 and R6	R: 51K $\frac{1}{2}$W 5%	01121	RC20
R7	R: 75Ω $\frac{1}{2}$W 5%	01121	RC20
R8	R: 6.8K $\frac{1}{4}$W 10%	01121	RC07
R9	R: 68Ω 2W	13606	
K1 thru K3	Relays	77342	65FP1A-24VDN
S1	S:	09353	7109RPC
T1	Transformer	81095	S0-7P
Q1	Transistor: NPN	15873	MPS6515
Q2 and Q3	Transistors: NPN	17803	2N3569
CR1	Diode	80368	1N2069
CR2 and CR3	Diodes	12065	1N4148
CR4 and CR5	Diodes	80368	1N2069
CR6	Diode	12065	1N4148
CR7 and CR8	Diodes	80368	1N2069

E95457 - D.C. Input

Ref Desig.	Description	Manufacturer (FSCM Code #)	Part Number
C1	C: 0.005μF 100V	13606	225P
C2	C: 200PF	84171	CM15E200J
C3	C: 0.1μF 100V	13606	225P
C4	C: 0.033μF 100V	13606	225P
C5	C: 0.005μF 100V	13606	225P
C6	C: 200pf	84171	CM15E200J
C7	C: 0.1μF 100V	13606	225P
C8	C: 0.033μF 100V	13606	225P
C9	C: 0.005μF 100V	13606	225P
C10 and C11	C: 200pf	84171	CM15E200J
C12 and C13	C: 0.1μF 100V	13606	225P
C14	C: 1μF 25V	13606	5C13
C15	C: 0.005μF 100V	13606	225P
C16	C: 200pf	84171	CM15E200J
C17	C: 1μF 25V	13606	5C13
C18	C: 0.005μF 100V	13606	225P
C19	C: 200pf	84171	CM15E200J
C20	C: 0.47μF 100V	13606	225P
C21	C: 22μF 6V	05397	K22W6K
C22	C: 0.001μF 100V	13606	225P
C23	C: 0.005μF 100V	13606	225P
C24	C: 0.033μF 100V	13606	225P
C25	C: 0.01μF 100V	13606	225P
R1	R: 270K $\frac{1}{4}$W 10%	01121	RC07
R2	R: 100K $\frac{1}{4}$W 10%	01121	RC07
R3	R: 1.5K $\frac{1}{4}$W 10%	01121	RC07
R4 and R5	R: 100K $\frac{1}{4}$W 10%	01121	RC07
R6	R: 390K $\frac{1}{4}$W 10%	01121	RC07
R7	R: 100K $\frac{1}{4}$W 10%	01121	RC07
R8	R: 1.5K $\frac{1}{4}$W 10%	01121	RC07
R9 and R10	R: 100K $\frac{1}{4}$W 10%	01121	RC07
R11	R: 390K $\frac{1}{4}$W 10%	01121	RC07
R12	R: 100K $\frac{1}{4}$W 10%	01121	RC07
R13	R: 1.5K $\frac{1}{4}$W 10%	01121	RC07
R14	R: 15K $\frac{1}{4}$W 10%	01121	RC07
R15	Pot: 1K	71450	SQ8415
R16	R: 56K $\frac{1}{4}$W 10%	01121	RC07
R17	R: 10K $\frac{1}{4}$W 10%	01121	RC07
R18 and R19	R: 220K $\frac{1}{4}$W 10%	01121	RC07
R20	R: 1K $\frac{1}{4}$W 10%	01121	RC07
R21	R: 27K $\frac{1}{4}$W 10%	01121	RC07
R22	R: 1K $\frac{1}{4}$W 10 %	01121	RC07

E95457 - (cont.)

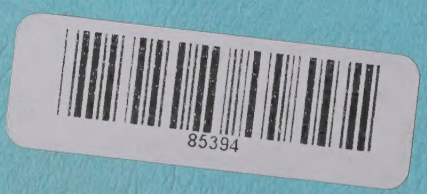
Ref Desig.	Description	Manufacturer (FSCM Code #)	Part Number
R23	R: 10K $\frac{1}{4}$W 10%	01121	RC07
R24	R: 68K $\frac{1}{4}$W 10%	01121	RC07
R25	R: 82K $\frac{1}{4}$W 10%	01121	RC07
R26	R: 15Ω $\frac{1}{4}$W 10%	01121	RC07
R27	R: 15K $\frac{1}{4}$W 10%.	01121	RC07
R28	R: 2.2K $\frac{1}{4}$W 10%	01121	RC07
R29	R: 2.7K $\frac{1}{4}$W 10%	01121	RC07
R30	R: 220Ω $\frac{1}{4}$W 10 %	01121	RC07
R31	R: 47K $\frac{1}{4}$W 10%	01121	RC07
R32	R: 15K $\frac{1}{4}$W 10%	01121	RC07
R33	R: 1M $\frac{1}{4}$W 10%	01121	RC07
R34 thru R36	R: 10K $\frac{1}{4}$W 10%	01121	RC07
R37	R: 56K $\frac{1}{4}$W 10%	01121	RC07
R38	R: 100K $\frac{1}{4}$W 10%	01121	RC07
R39	R: 22K $\frac{1}{4}$W 10%	01121	RC07
R40	R: 1.5K $\frac{1}{4}$W 10%	01121	RC07
R41	R: 100Ω $\frac{1}{4}$W 10%	01121	RC07
R42	R: 10K $\frac{1}{4}$W 10%	01121	RC07
R43	R: 100K $\frac{1}{4}$W 10%	01121	RC07
R44	R: 10K $\frac{1}{4}$W 10%	01121	RC07
R45 thru R47	R: 100K $\frac{1}{4}$W 10%	01121	RC07
R48	R: 1.5K $\frac{1}{4}$W 10%	01121	RC07
R49	R: 5.6K $\frac{1}{4}$W 10%	01121	RC07
R50	R: 1.2K $\frac{1}{4}$W 10%	01121	RC07
R51	R: 68Ω $\frac{1}{4}$W 10%	01121	RC07
R52	R: 10K $\frac{1}{4}$W 10%	01121	RC07
R53	R: 1.5K $\frac{1}{4}$W 10%	01121	RC07
R54 and R55	R: 22K $\frac{1}{4}$W 10%	01121	RC07
K1	Relay	83612	25M1C
T1	Transformer	81095	S0-7P
Q1	Transistor: PNP	17803	2N4356
Q2	Transistor: NPN	17803	2N3569
Q3 and Q4	Transistors: PNP	17803	2N4356
Q5	Transistor: NPN	15873	MPS6515
Q6 thru Q9	Transistors: NPN	17803	2N3569
Q10	Transistor: P-Channel	15873	MPF152
CR1	Diode	81071	SZ11
CR2 thru CR6	Diodes	12065	1N4148
CR7 and CR8	Diodes	80368	1N198
CR9 thru CR14	Diodes	80368	SV-1
IC1 thru IC3	Integrated circuits	15873	MC1437L

E95458 - A. C. Input

Ref Desig.	Description	Manufacturer (FSCM Code #)	Part Number
C1 and C2	C: 0.01μF 100V	13606	225P
C3	C: 0.005μF 100V	13606	225P
C4	C: 200pf	84171	CM15E200J
C5 and C6	C: 0.01μF 100V	13606	225P
C7	C: 0.005μF 100V	13606	225P
C8	C: 200pf	84171	CM15E200J
C9 and C10	C: 0.33μF 100V	13606	225P
C11	C: 0.27μF 100V	13606	225P
C12	C: 0.005μF 100V	13606	225P
C13	C: 200pf	84171	CM15E200J
C14 and C15	C: 0.33μF 100V	13606	225P
C16	C: 0.27μF 100V	13606	225P
C17	C: 0.005μF 100V	13606	225P
C18	C: 200pf	84171	CM15E200J
C19 thru C21	C: sel val		
C22 and C23	C: 0.33μF 100V	13606	225P
C24 thru C26	C: sel val		
R1	R: 38.32K 1%	07716	CEA
R2	R: 75.02K 1%	07716	CEA
R3	R: 22K $\frac{1}{4}$W 10%	01121	RC07
R4	R: 100K $\frac{1}{4}$W 10 %	01121	RC07
R5	R: 1.5K $\frac{1}{4}$W 10%	01121	RC07
R6	R: 38.32K 1%	07716	CEA
R7	R: 75.02K 1%	07716	CEA
R8	R: 22K $\frac{1}{4}$W 10%	01121	RC07
R9	R: 100K $\frac{1}{4}$W 10%	01121	RC07
R10	R: 1.5K $\frac{1}{4}$W 10%	01121	RC07
R11	R: 120Ω $\frac{1}{4}$W 10%	01121	RC07
R12	R: 10K $\frac{1}{4}$W 10%	01121	RC07
R13	R: 220Ω $\frac{1}{4}$W 10%	01121	RC07
R14	R: 10K $\frac{1}{4}$W 10%	01121	RC07
R15	R: 1.5K $\frac{1}{4}$W 10%	01121	RC07
R16	Pot: 1K	71450	SQ8415
R17	R: 330Ω $\frac{1}{4}$W 10%	01121	RC07
R18	R: 10K $\frac{1}{4}$W 10%	01121	RC07
R19	R: 220Ω $\frac{1}{4}$W 10%	01121	RC07
R20	R: 10K $\frac{1}{4}$W 10 %	01121	RC07
R21	R: 1.5K $\frac{1}{4}$W 10%	01121	RC07
R22	R: 1K Pot	71450	SQ8415
L1 and L3	Ind: 37.4mh	06819	
L2	Ind: 51mh	06819	
L4 and L6	Ind: 82.9mh	06819	

E95458 - (cont.)

Ref Desig.	Description	Manufacturer (FSCM Code #)	Part Number
L5	Ind: 104mh	06819	
CR1	Diode	81071	SZ11
CR2 and CR3	Diodes	81071	SV-1
IC1 and IC2	Integrated circuits	15873	MC1437L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